20120702685008

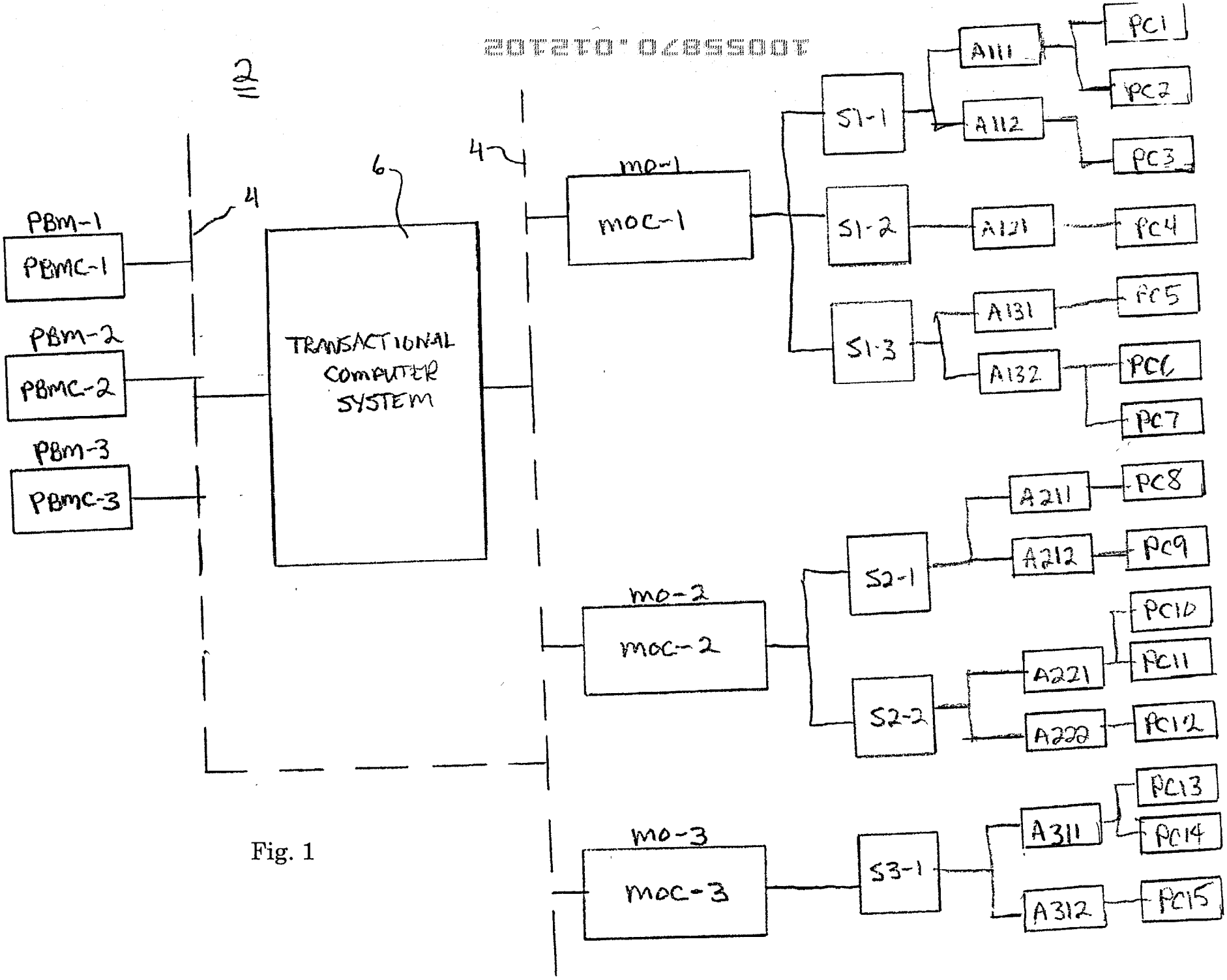

Fig. 1

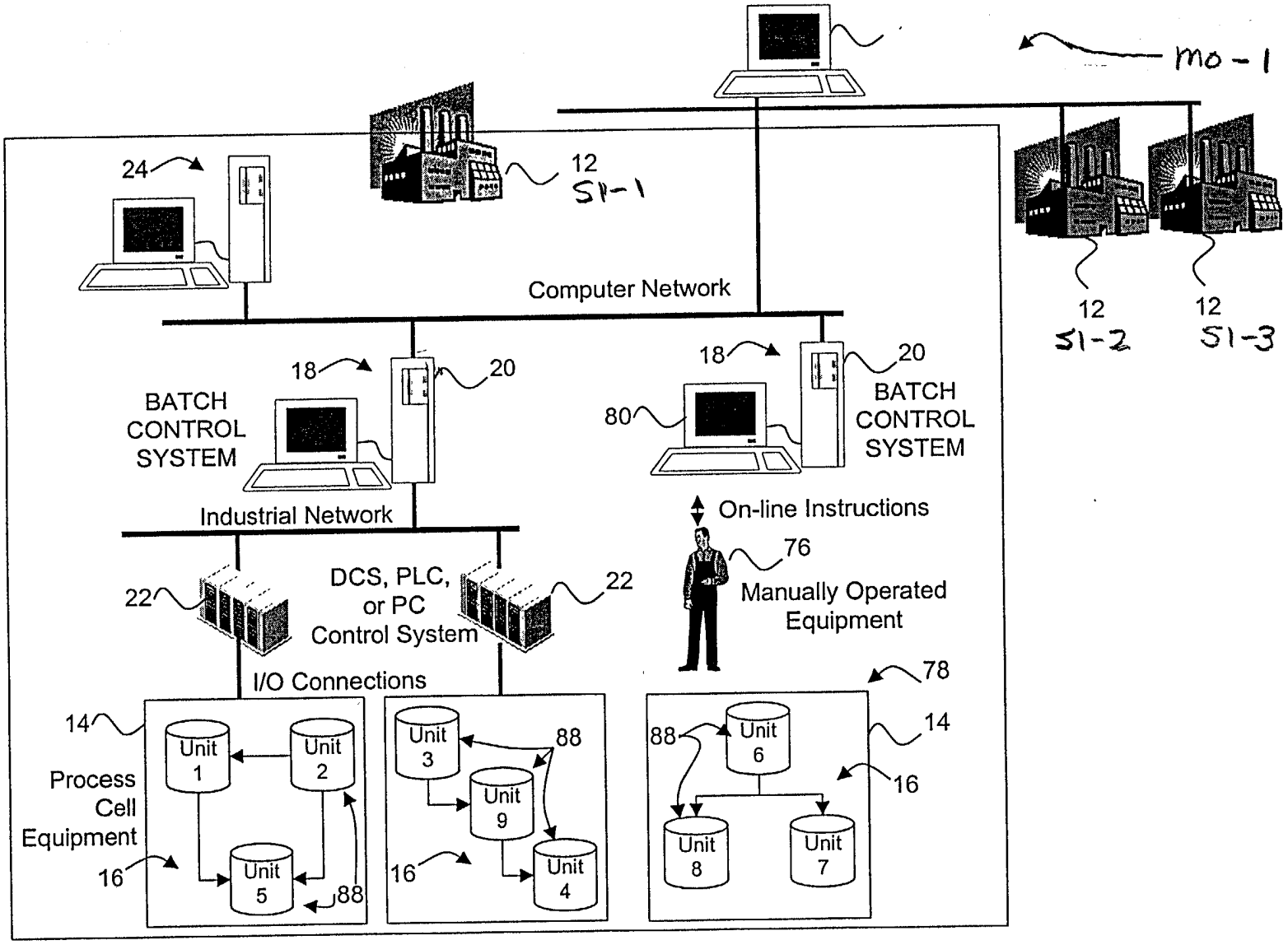
mo-1
12
S1-1
12
S1-2
12
S1-3
24
Computer Network
18
20
BATCH
CONTROL
SYSTEM
18
20
80
BATCH
CONTROL
SYSTEM
Industrial Network
On-line Instructions
76
Manually Operated
Equipment
22
DCS, PLC,
or PC
Control System
22
I/O Connections
78
14
14
Process
Cell
Equipment
16
16
16
88
88
88
Unit
1
Unit
2
Unit
3
Unit
9
Unit
4
Unit
5
Unit
6
Unit
8
Unit
7

Fig. 2

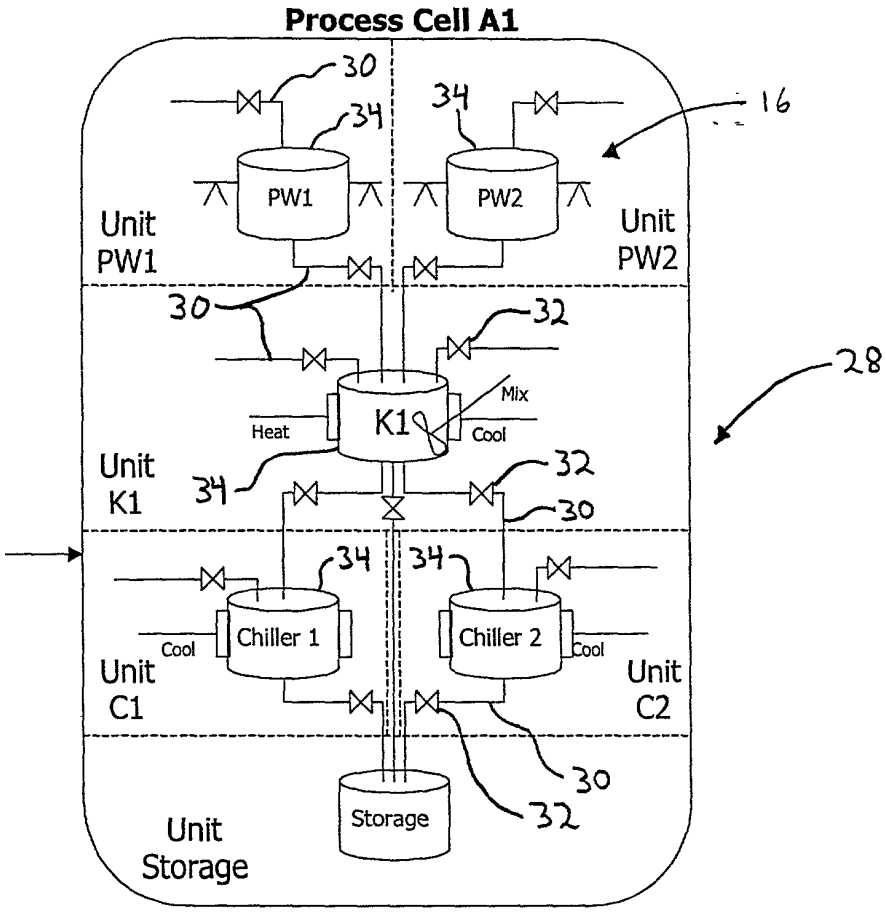
Process Cell A1
30
34
34
16
PW1
PW2
Unit
PW1
Unit
PW2
30
32
28
Mix
Heat
K1
Cool
Unit
K1
34
32
30
34
34
Cool
Chiller 1
Chiller 2
Cool
Unit
C1
Unit
C2
30
32
Storage
Unit
Storage

Fig. 3

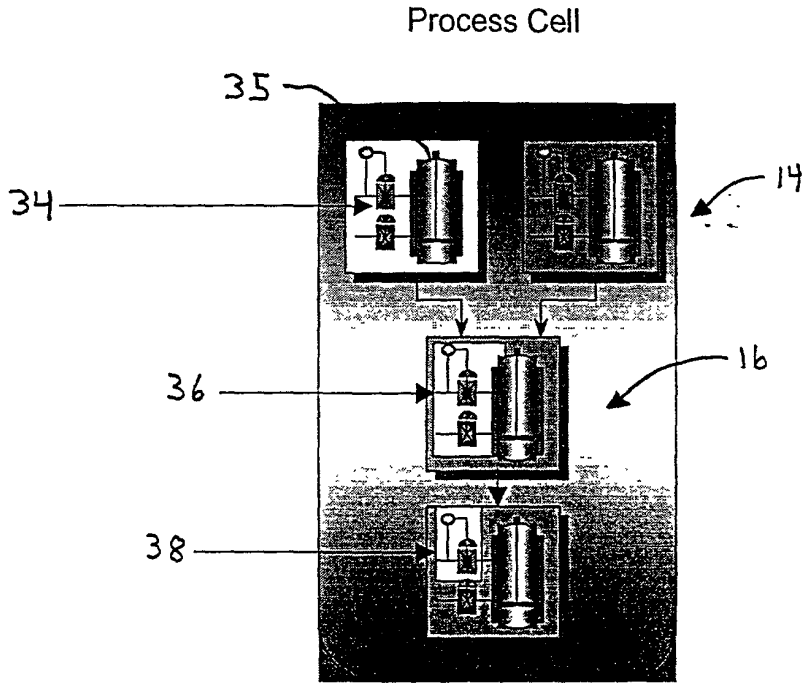
Process Cell
35
34
14
36
16
38

Fig. 4

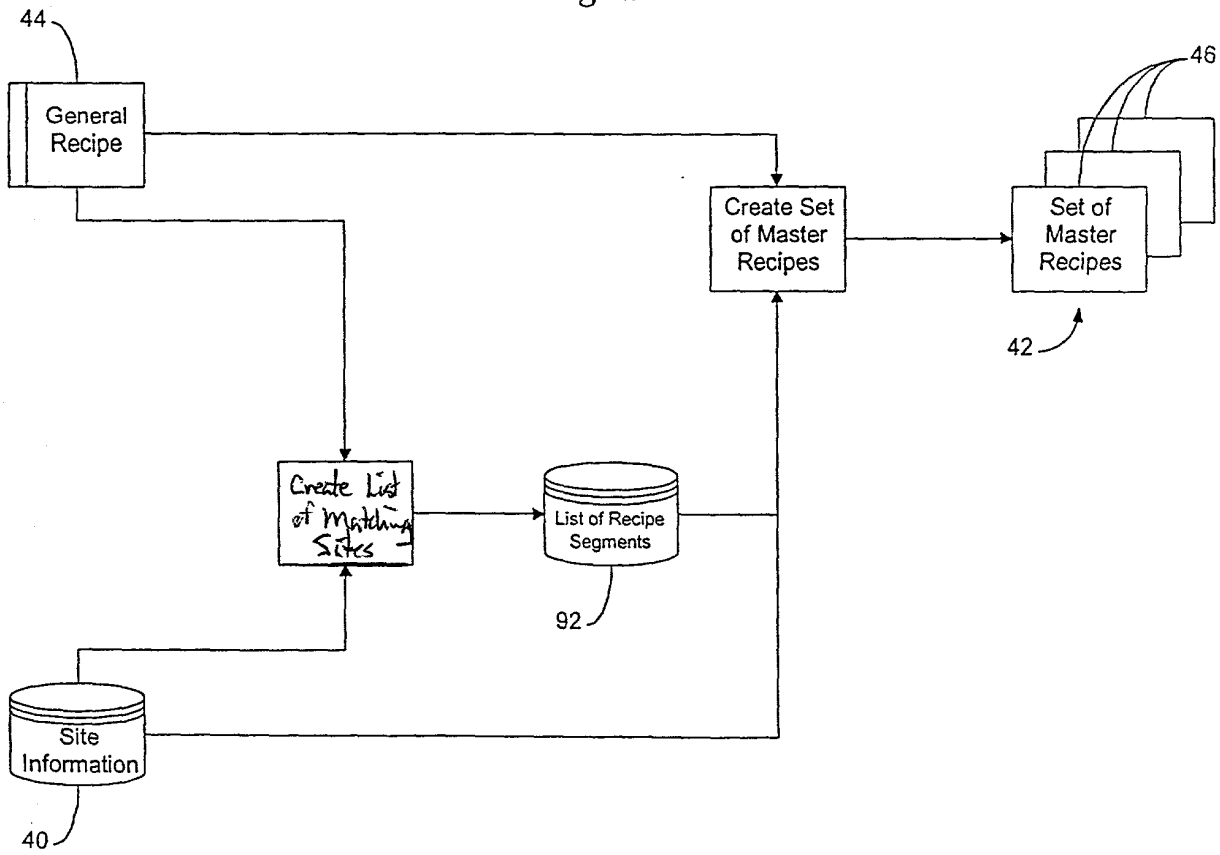
44
General Recipe
46
Create Set of Master Recipes
Set of Master Recipes
42
Create List of Matching Sites
List of Recipe Segments
92
Site Information
40

Fig. 5

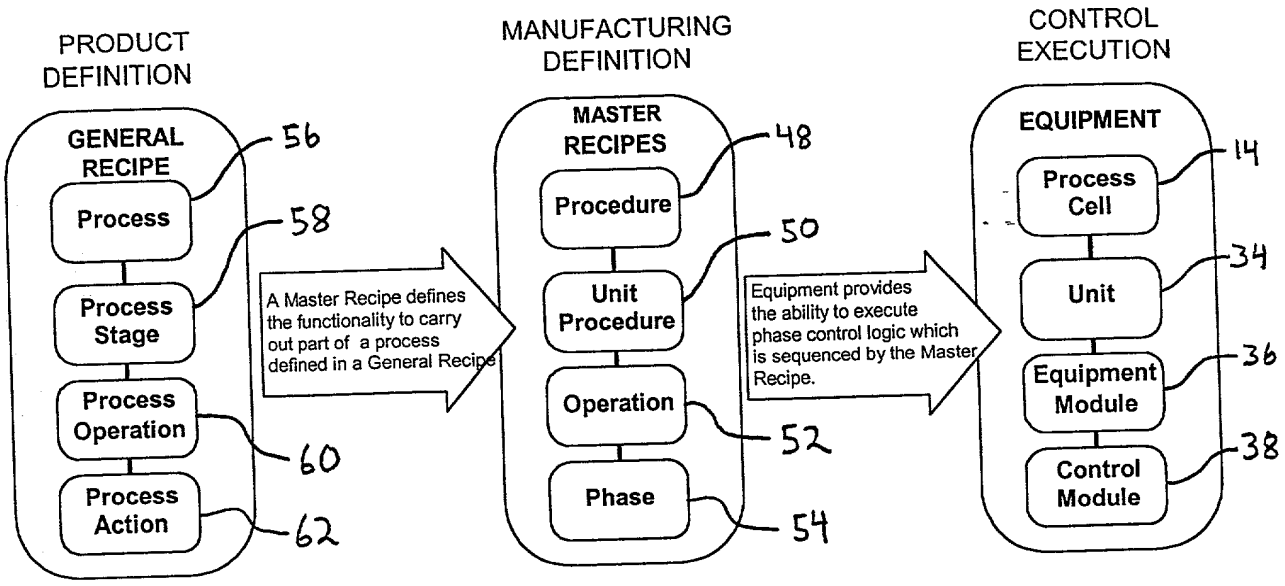
PRODUCT DEFINITION
MANUFACTURING DEFINITION
CONTROL EXECUTION
GENERAL RECIPE
Process
Process Stage
Process Operation
Process Action
56
58
60
62
A Master Recipe defines the functionality to carry out part of a process defined in a General Recipe
MASTER RECIPES
Procedure
Unit Procedure
Operation
Phase
48
50
52
54
Equipment provides the ability to execute phase control logic which is sequenced by the Master Recipe.
EQUIPMENT
Process Cell
Unit
Equipment Module
Control Module
14
34
36
38

Fig. 6

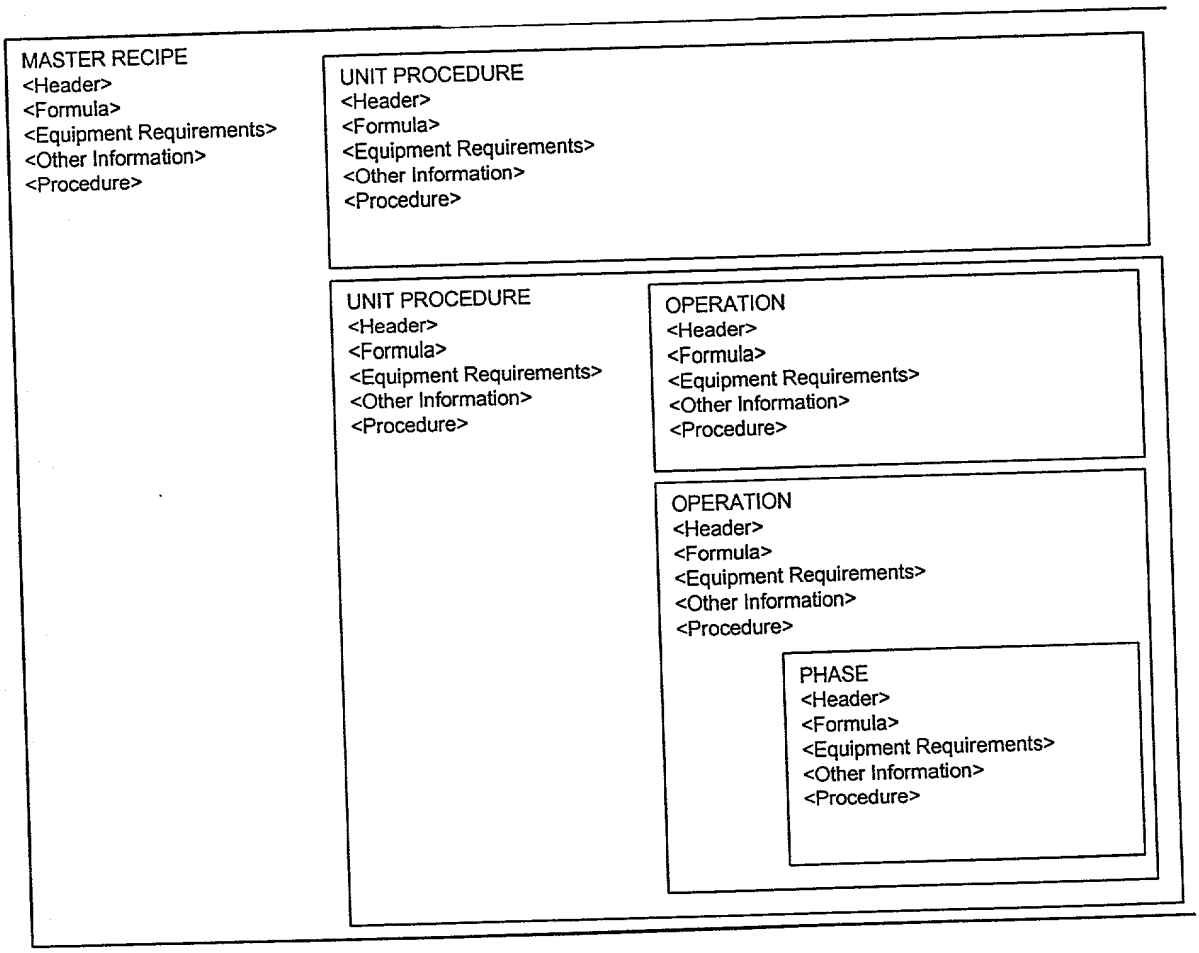
MASTER RECIPE
<Header>
<Formula>
<Equipment Requirements>
<Other Information>
<Procedure>
UNIT PROCEDURE
<Header>
<Formula>
<Equipment Requirements>
<Other Information>
<Procedure>
UNIT PROCEDURE
<Header>
<Formula>
<Equipment Requirements>
<Other Information>
<Procedure>
OPERATION
<Header>
<Formula>
<Equipment Requirements>
<Other Information>
<Procedure>
OPERATION
<Header>
<Formula>
<Equipment Requirements>
<Other Information>
<Procedure>
PHASE
<Header>
<Formula>
<Equipment Requirements>
<Other Information>
<Procedure>

Fig. 7

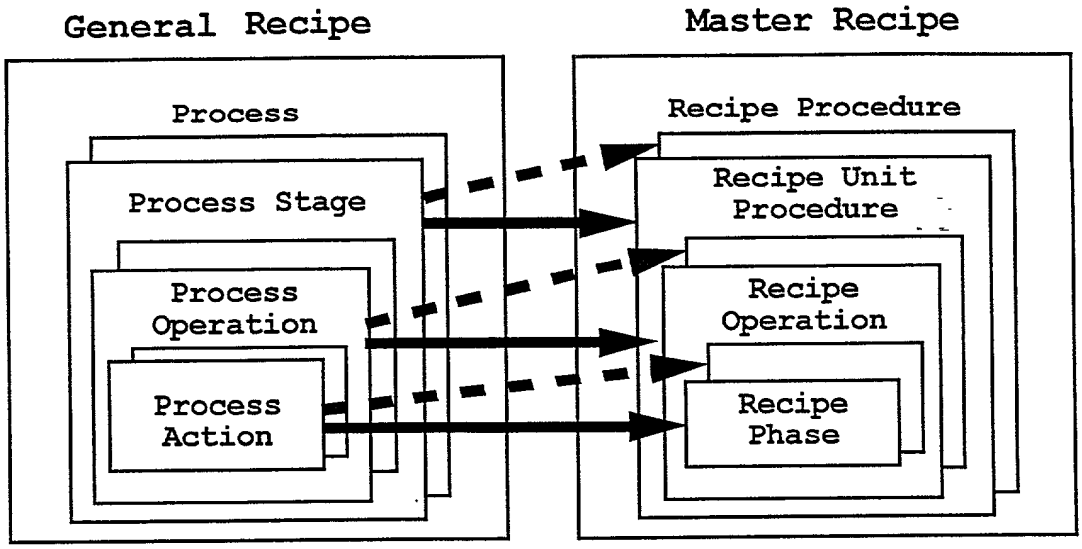
General Recipe
Master Recipe
Process
Process Stage
Process Operation
Process Action
Recipe Procedure
Recipe Unit Procedure
Recipe Operation
Recipe Phase

Fig. 8

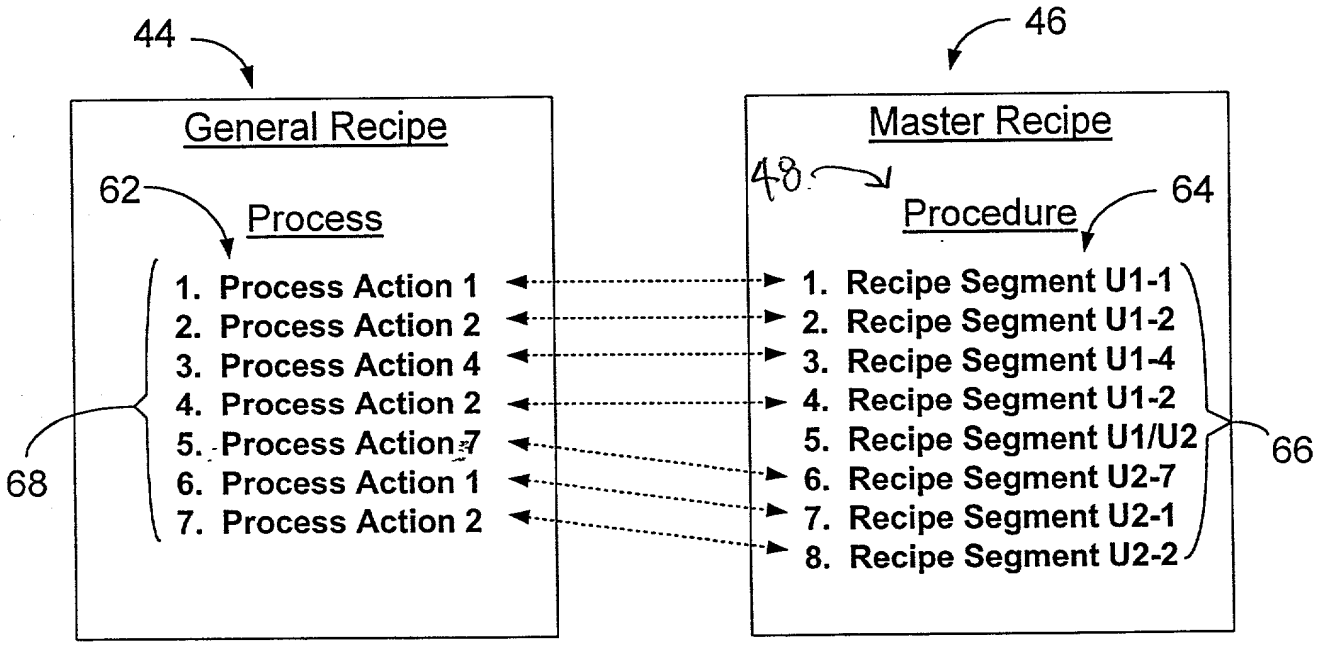
44
46
General Recipe
62
Process
1. Process Action 1
2. Process Action 2
3. Process Action 4
4. Process Action 2
5. Process Action 7
6. Process Action 1
7. Process Action 2
68
Master Recipe
48
Procedure
64
1. Recipe Segment U1-1
2. Recipe Segment U1-2
3. Recipe Segment U1-4
4. Recipe Segment U1-2
5. Recipe Segment U1/U2
6. Recipe Segment U2-7
7. Recipe Segment U2-1
8. Recipe Segment U2-2
66

Fig. 9

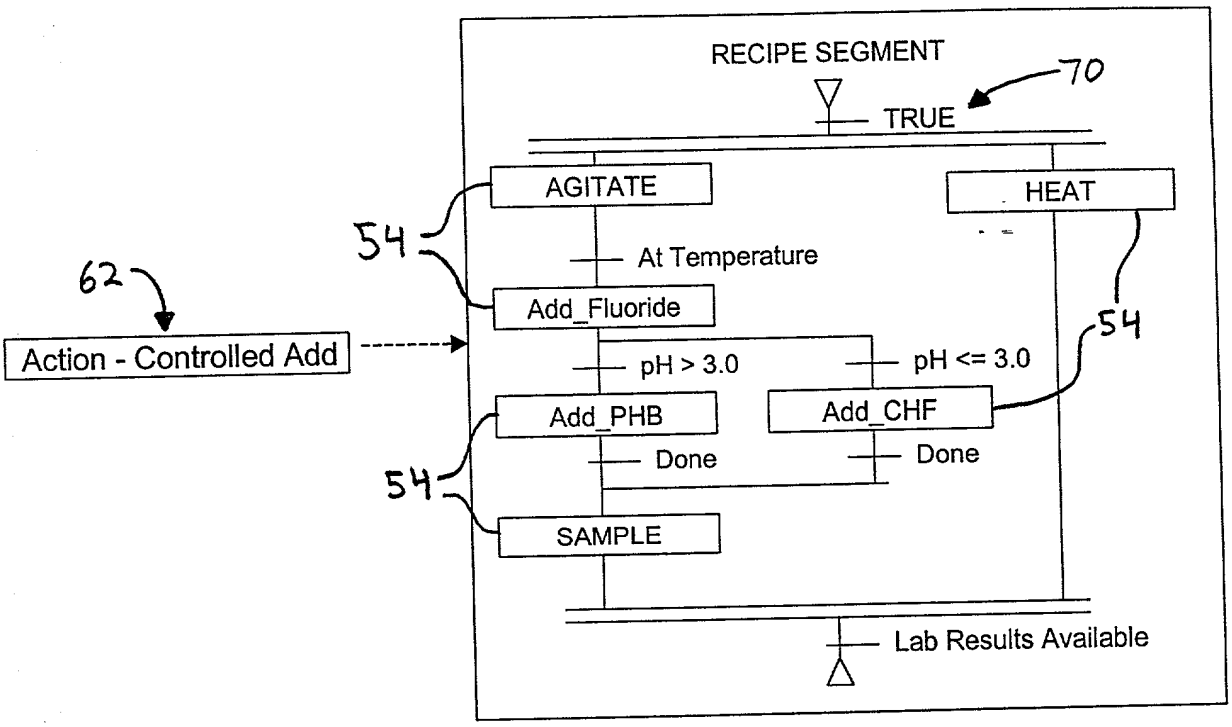
RECIPE SEGMENT
70
TRUE
AGITATE
HEAT
54
At Temperature
62
Add_Fluoride
Action - Controlled Add
54
pH > 3.0
pH <= 3.0
Add_PHB
Add_CHF
Done
Done
54
SAMPLE
Lab Results Available

Fig. 10

General Recipe Procedure	Master Recipe Procedure
	1. Open purge valve PV1 to unit U1. 2. Activate purge pump PP1. 3. Deactivate discharge pump PP1 after 5 minutes. 4. Close discharge valve PV1.
1. Add 0.5 lbs material A per pound product C required.	5. Open inlet valve IV1A to unit U1. (to material A) 6. Read unit U1 weight on load cell LC1, store initial weight 1. 7. Activate inlet pump IP1A. (to material A) 8. Read load cell LC1, when weight - initial weight 1 = 0.5 X lbs product reqd., deactivate IP1A. 9. Close inlet valve IV1A.
2. Add 0.5 lbs material B per pound product C required.	10. Open inlet valve IV1B to unit U1. (to material B) 11. Read weight on load cell LC1, store initial weight 2. 12. Activate inlet pump IP1B. (to material B) 13. Read load cell LC1, when weight - initial weight 2 = 0.5 X lbs product reqd., deactivate IP1B. 14. Close inlet valve IV1B.
3. Mix for 30 minutes at 1/2 turn over of material per minute.	15. Activate mixer M1 on unit U1 at 15 rpm. 16. Deactivate mixer M1 after 30 minutes. 17. Open flow valve FV1/2 from unit U1 to unit U2. 18. Read unit U2 weight on load cell LC2, store initial weight 3. 19. Activate flow pump FP1/2 (from unit U1 to unit U2). 20. Read load cell LC2, when weight - initial weight 3 = 1 X lbs product reqd., deactivate FP1/2. 21. Close flow valve FV1/2. 22. Read unit U1 weight on load cell LC1, verify weight = initial weight 1, else activate alarm A1 to operator.
4. Heat mixture for 45 minutes at 90 degrees C.	23. Activate heater H2 on unit U2. 24. Monitor temperature sensor TS2 on U2, using H2, control TS2 to 90 degrees C for 45 minutes.
5. Allow product to cool to < 40 degrees C.	25. Deactivate HS2, monitor TS2, when temp. < 40 degrees C, open discharge valve DV2C to tank C.
6. Discharge 1 pound product C.	26. Activate discharge pump DP2C to tank C. 27. Monitor unit 2 load cell LC2, when weight = initial weight 3, deactivate discharge pump DP2C. 28. Close valve DV2C.
	29. Open purge valve PV2 to unit U2. 30. Activate discharge pump PP2 to unit U2. 31. Deactivate discharge pump PP2 after 5 minutes. 32. Close discharge valve PV2.

Fig. 11

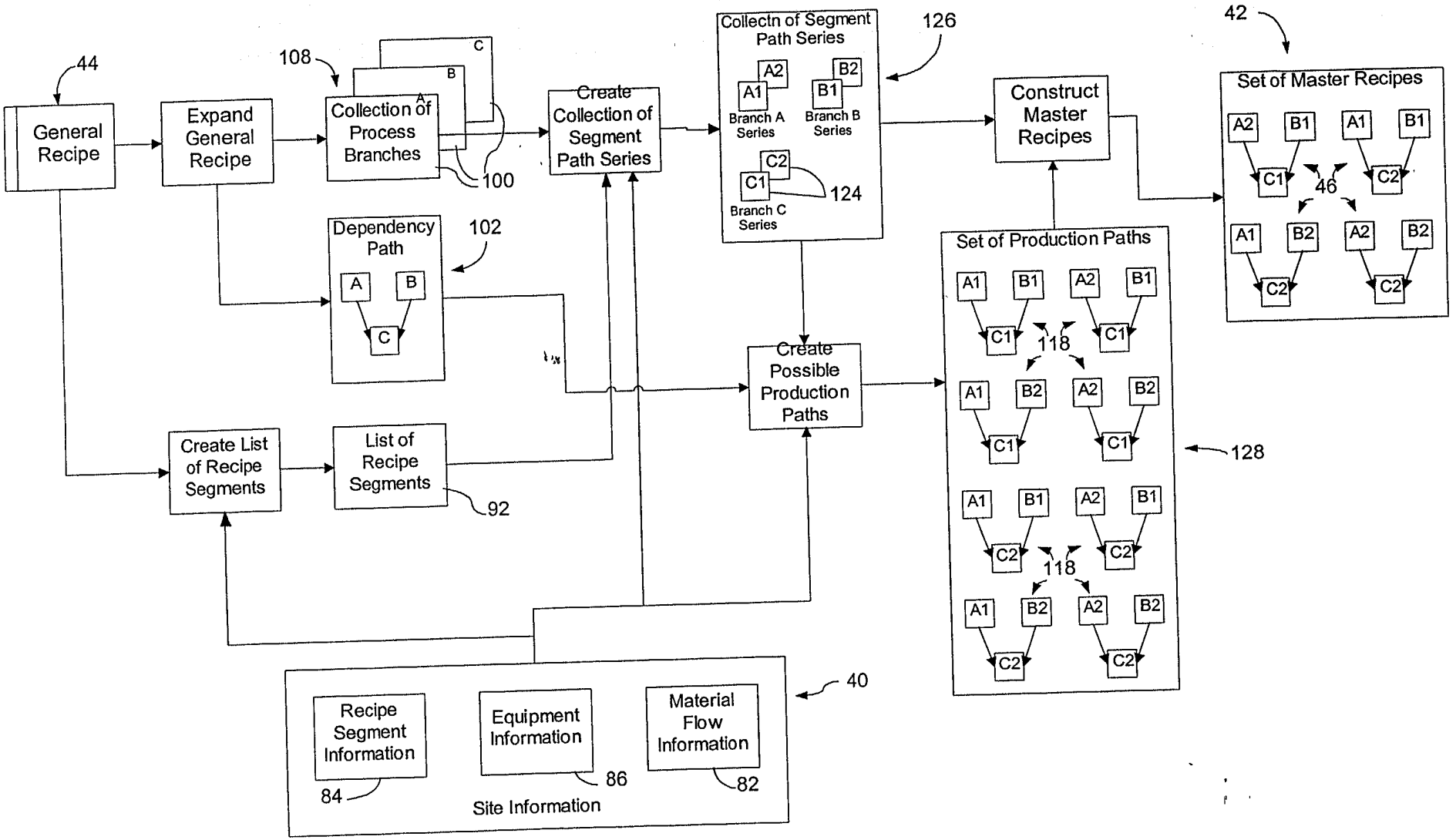
44
General Recipe
Expand General Recipe
108
Collection of Process Branches
A
B
C
100
Create Collection of Segment Path Series
Collectn of Segment Path Series
126
A2
A1
Branch A Series
B2
B1
Branch B Series
C2
C1
124
Branch C Series
Construct Master Recipes
42
Set of Master Recipes
A2
B1
A1
B1
C1
46
C2
A1
B2
A2
B2
C2
C2
Dependency Path
102
A
B
C
Create List of Recipe Segments
List of Recipe Segments
92
Create Possible Production Paths
Set of Production Paths
A1
B1
A2
B1
C1
118
C1
A1
B2
A2
B2
C1
C1
128
A1
B1
A2
B1
C2
118
C2
A1
B2
A2
B2
C2
C2
40
Recipe Segment Information
84
Equipment Information
86
Material Flow Information
82
Site Information

Fig. 12

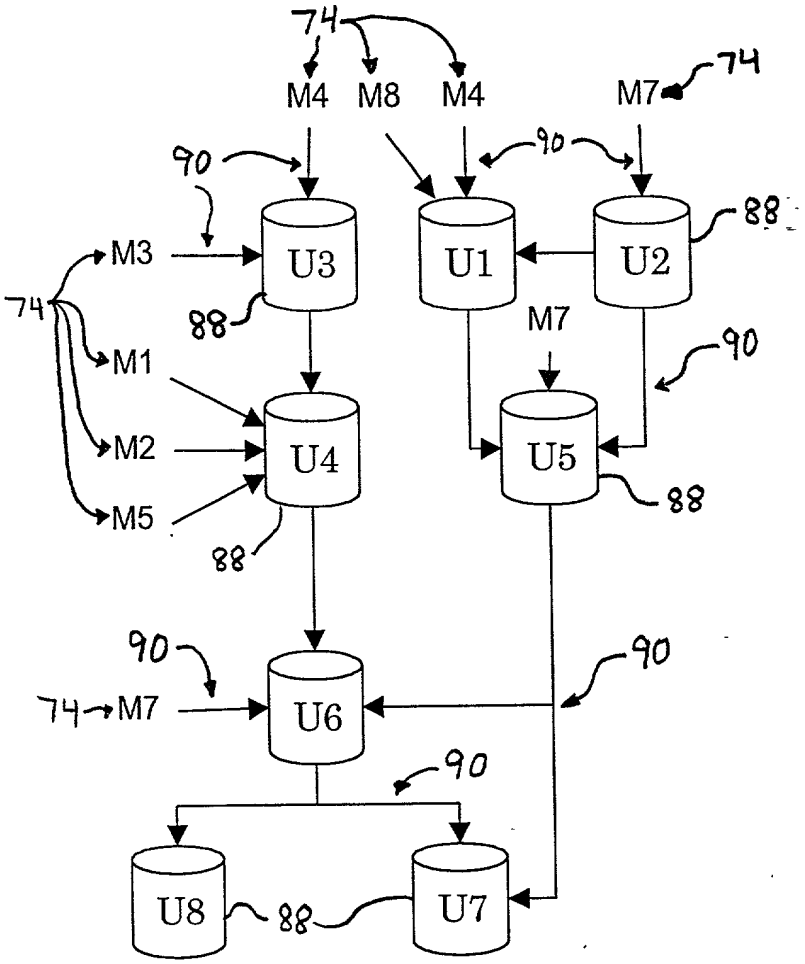
74
M4
M8
M4
M7
74
90
90
88
M3
U3
U1
U2
74
88
M7
90
M1
M2
U4
U5
M5
88
88
90
90
74
M7
U6
90
90
U8
88
U7

Fig. 13

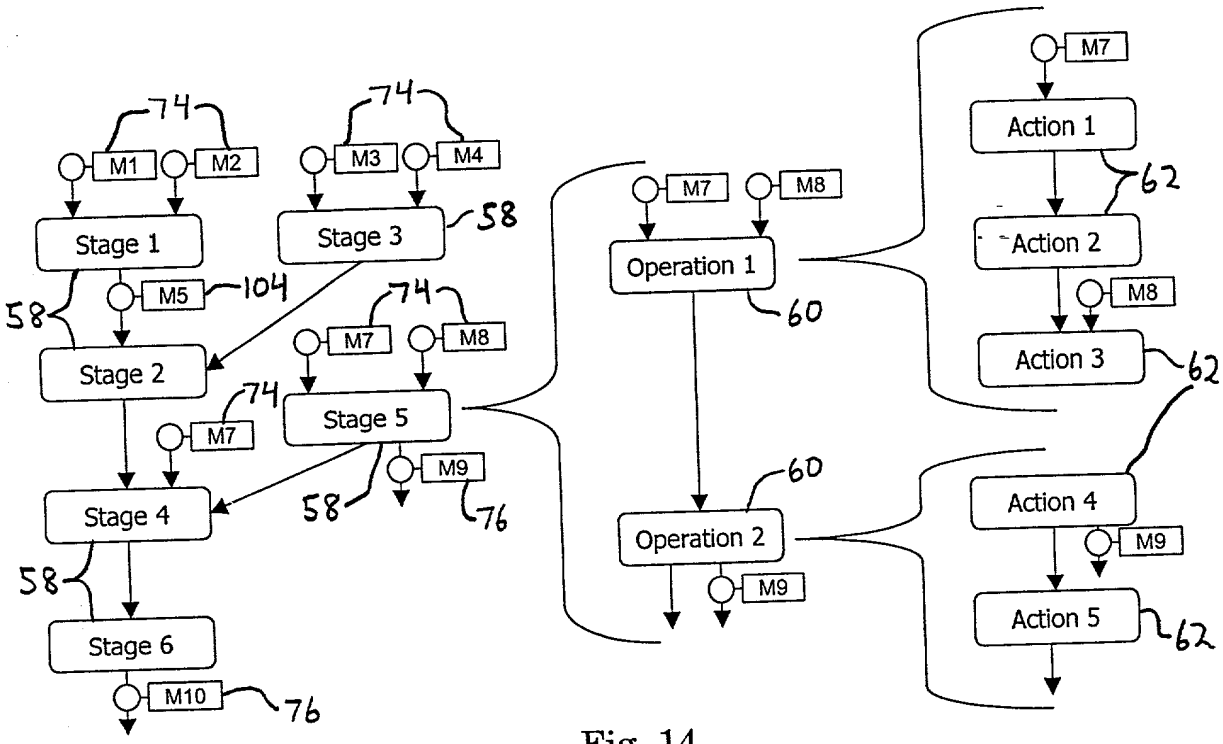
74
M1
M2
74
M3
M4
Stage 1
Stage 3
58
M5
104
58
74
M7
M8
Stage 2
Stage 5
74
M7
M9
58
76
Stage 4
58
Stage 6
M10
76
M7
M8
Operation 1
60
60
Operation 2
M9
M7
Action 1
62
Action 2
M8
Action 3
62
Action 4
M9
Action 5
62

Fig. 14

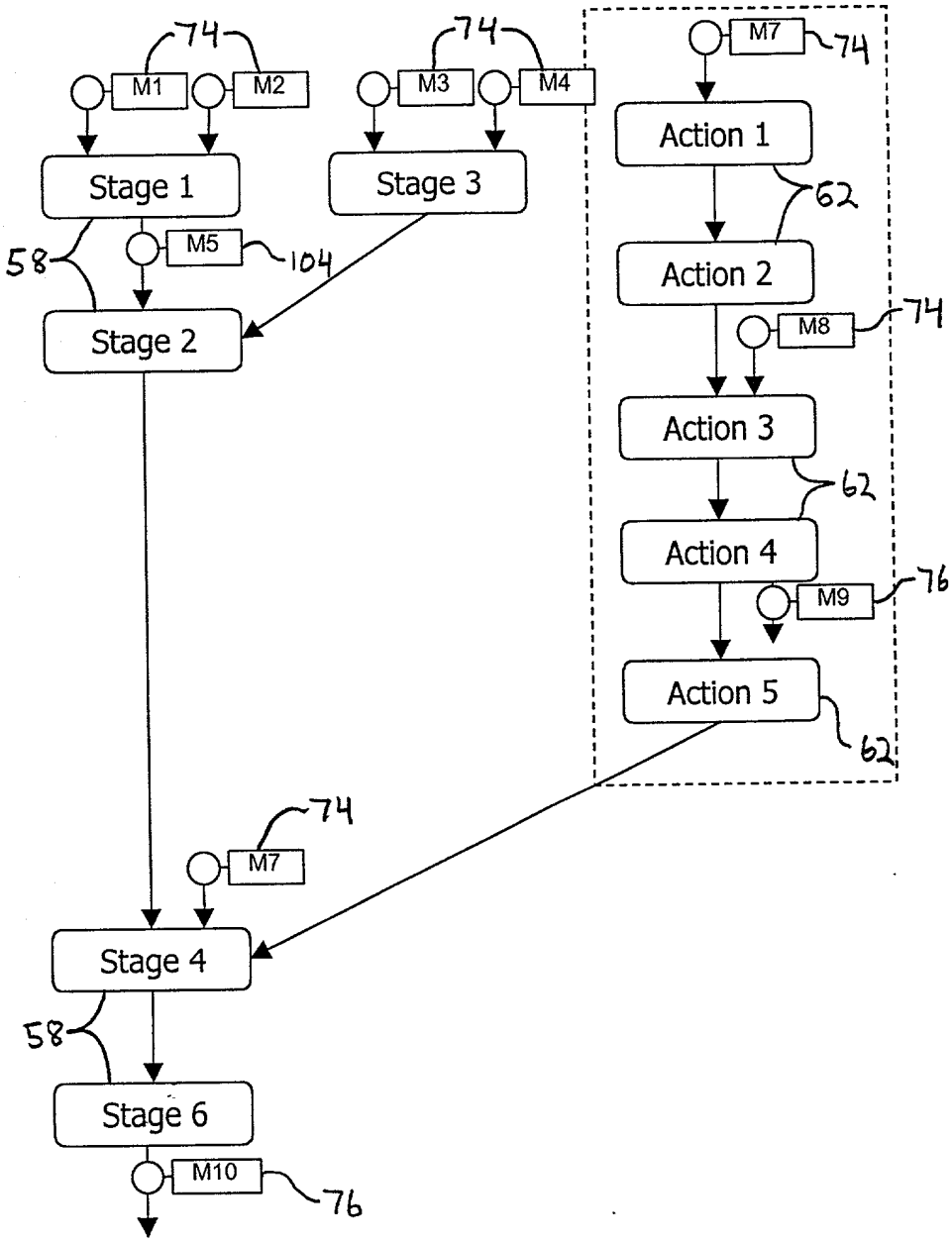
74
M1
M2
74
M3
M4
M7
74
Action 1
Stage 1
Stage 3
62
58
M5
104
Action 2
M8
74
Stage 2
Action 3
62
Action 4
M9
76
Action 5
62
74
M7
Stage 4
58
Stage 6
M10
76

Fig. 15

Unit From	Unit To	Transfer From Recipe Segment	Transfer To Recipe Segment
U2	U1	SEG U2-T5	SEG U1-T2
U2	U5	SEG U2-T5	SEG U5-T2
U1	U5	SEG U1-T5	SEG U5-T1
U3	U4	SEG U3-T4	SEG U4-T3
U4	U6	SEG U4-T6	SEG U6-T4
U5	U6	SEG U5-T6	SEG U6-T5
U5	U7	SEG U5-T7	SEG U7-T5
U6	U7	SEG U6-T7	SEG U7-T6
U6	U8	SEG U6-T8	SEG U8-T6

Fig. 16

Recipe Segment	Unit	Class	Material	Action
SEG U1-1-7	U1	No	M7	Action 1
SEG U1-2	U1	No		Action 2
SEG U1-3-8	U1	No	M8	Action 3
SEG U1-5	U1	No		Action 5
SEG U1-4	U1	No		Action 4
SEG U2-1-7	U2	No	M7	Action 1
SEG U2-1-7B	U2	No	M7	Action 1
SEG U3-15-3	U3	Yes	M3	Action 15
SEG U3-16	U3	Yes		Action 16
SEG U3-17-4	U3	Yes	M4	Action 17
SEG U4-1-5	U4	No	M5	Action 1
SEG U4-16	U4	No		Action 16
SEG U4-17	U4	No		Action 17
SEG U4-5	U4	No		Action 5
SEG U4-3-1	U4	Yes	M1	Action 3
SEG U4-3-2	U4	No	M2	Action 3
SEG U4-7	U4	Yes		Action 7
SEG U5-1-7	U5	No	M7	Action 1
SEG U5-5	U5	No		Action 5
SEG U5-4	U5	No		Action 4
SEG U6-1-7	U6	No	M7	Action 1
SEG U6-5	U6	No		Action 5
SEG U6-7	U6	Yes		Action 7
SEG U7-6	U7	No		Action 6
SEG U7-10	U7	No		Action 10
SEG U8-6	U8	No		Action 6
SEG U8-10	U8	No		Action 10

Fig. 17

Unit	Start Recipe Segment	End Recipe Segment
U1	SEG U1-S	<null>
U2	SEG U2-S	SEG U2-E
U3	<null>	SEG U3-E
U4	SEG U4-S	SEG U4-E
U5	<null>	<null>
U6	<null>	<null>
U7	<null>	<null>
U8	<null>	<null>

Fig. 18

Unit	Material of Construction	Unit Type	Volume	Agitation Speed		Temperature		Pressure	
				Max.	Min	Max.	Min.	Max.	Min.
U1	SS	Mixer	10000	200	0	<NULL>	<NULL>	<NULL>	<NULL>
U2	SS	Chiller	5000	20	20	<NULL>	-50	<NULL>	<NULL>
U3	SS/GL	Mixer	5000	100	0	<NULL>	<NULL>	30	-1
U4	SS/GL	Reactor	3000	100	0	300	-50	100	-1
U5	SS	Reactor	5000	100	0	250	<NULL>	50	<NULL>
U6	SS/GL	Reactor	2000	50	0	400	-100	100	-1
U7	SS	Separator	5000	100	0	300	-50	30	-1
U8	SS/GL	Separator	10000	200	0	250	<NULL>	10	-1

Fig. 19

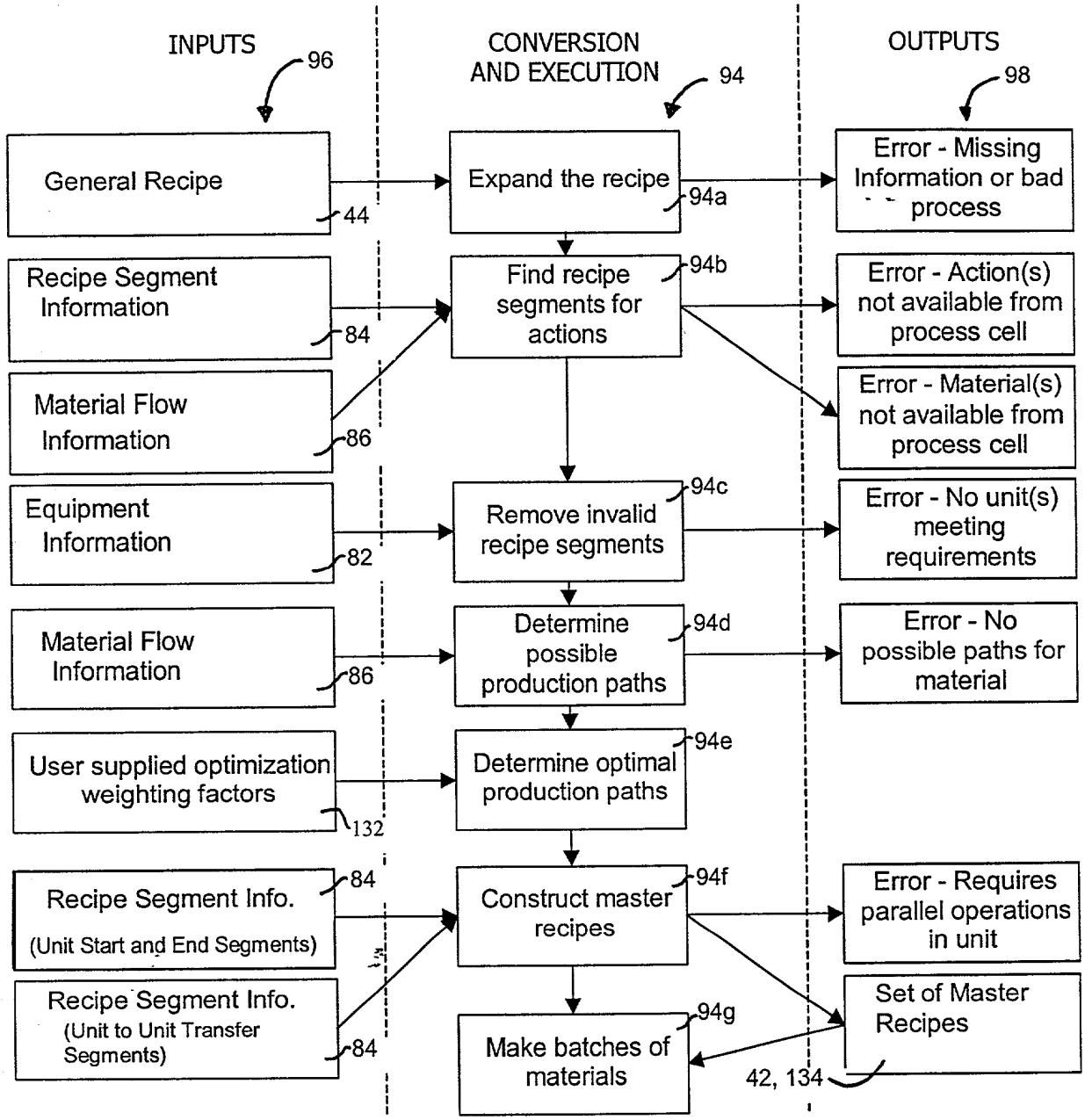
INPUTS
96
CONVERSION AND EXECUTION
94
OUTPUTS
98
General Recipe
44
Expand the recipe
94a
Error - Missing Information or bad process
Recipe Segment Information
84
Find recipe segments for actions
94b
Error - Action(s) not available from process cell
Material Flow Information
86
Error - Material(s) not available from process cell
Equipment Information
82
Remove invalid recipe segments
94c
Error - No unit(s) meeting requirements
Material Flow Information
86
Determine possible production paths
94d
Error - No possible paths for material
User supplied optimization weighting factors
132
Determine optimal production paths
94e
Recipe Segment Info.
(Unit Start and End Segments)
84
Construct master recipes
94f
Error - Requires parallel operations in unit
Recipe Segment Info.
(Unit to Unit Transfer Segments)
84
Make batches of materials
94g
Set of Master Recipes
42, 134

Fig. 20

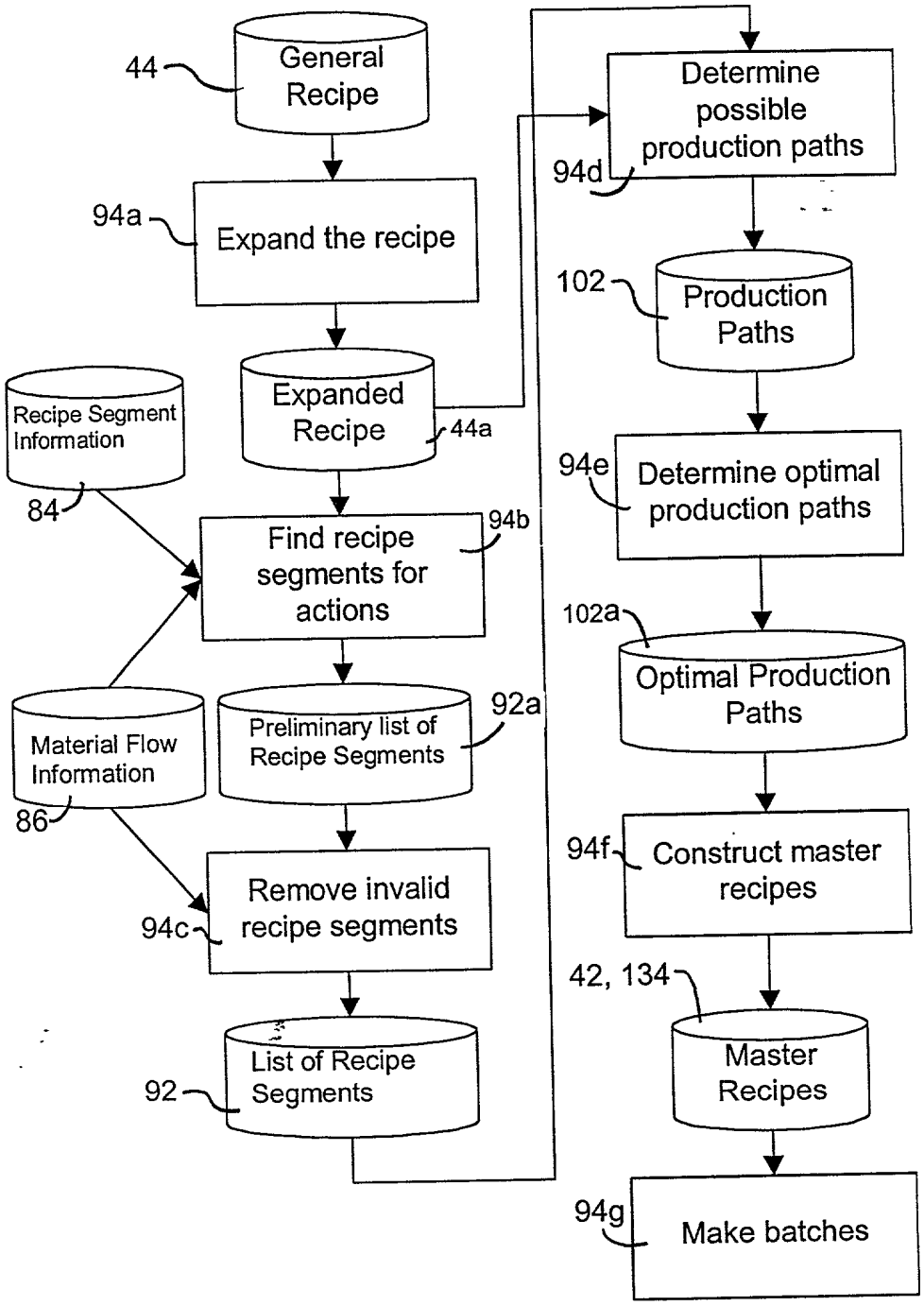
44
General Recipe
94a
Expand the recipe
Expanded Recipe
44a
Recipe Segment Information
84
Find recipe segments for actions
94b
Material Flow Information
86
Preliminary list of Recipe Segments
92a
Remove invalid recipe segments
94c
List of Recipe Segments
92
Determine possible production paths
94d
Production Paths
102
Determine optimal production paths
94e
Optimal Production Paths
102a
Construct master recipes
94f
Master Recipes
42, 134
Make batches
94g

Fig. 21

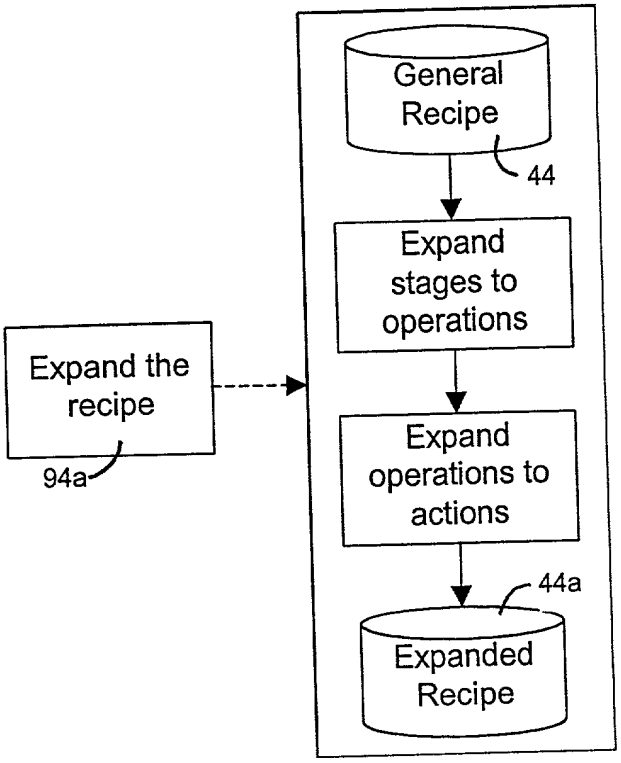
General Recipe
44
Expand stages to operations
Expand the recipe
94a
Expand operations to actions
44a
Expanded Recipe

Fig. 22

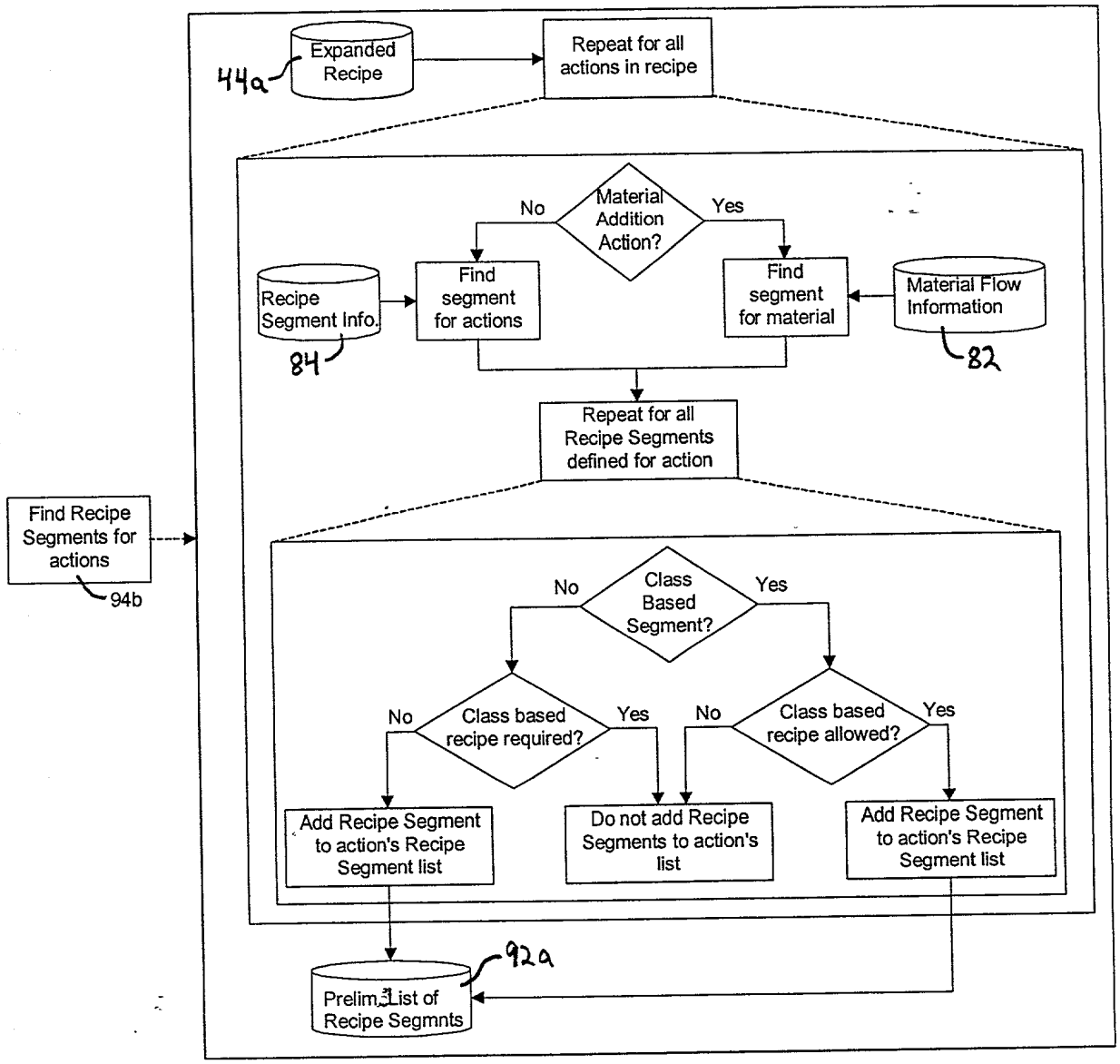
Expanded Recipe
44a
Repeat for all actions in recipe
Material Addition Action?
No
Yes
Recipe Segment Info.
84
Find segment for actions
Find segment for material
Material Flow Information
82
Repeat for all Recipe Segments defined for action
Find Recipe Segments for actions
94b
Class Based Segment?
No
Yes
Class based recipe required?
No
Yes
Class based recipe allowed?
No
Yes
Add Recipe Segment to action's Recipe Segment list
Do not add Recipe Segments to action's list
Add Recipe Segment to action's Recipe Segment list
92a
Prelim. List of Recipe Segmnts

Fig. 23

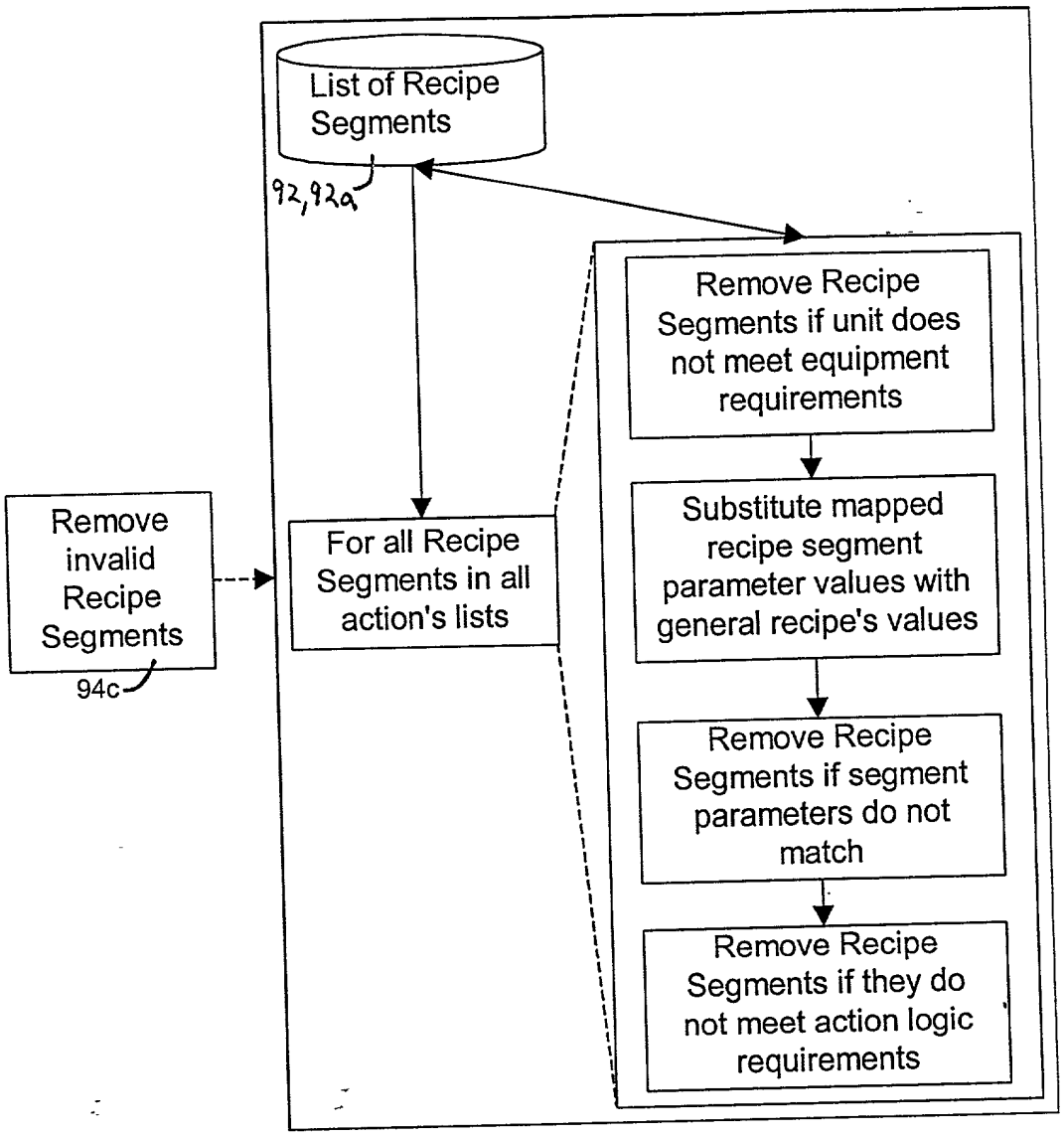
List of Recipe Segments
92,92a
Remove Recipe Segments if unit does not meet equipment requirements
Substitute mapped recipe segment parameter values with general recipe's values
Remove Recipe Segments if segment parameters do not match
Remove Recipe Segments if they do not meet action logic requirements
Remove invalid Recipe Segments
94c
For all Recipe Segments in all action's lists

Fig. 24

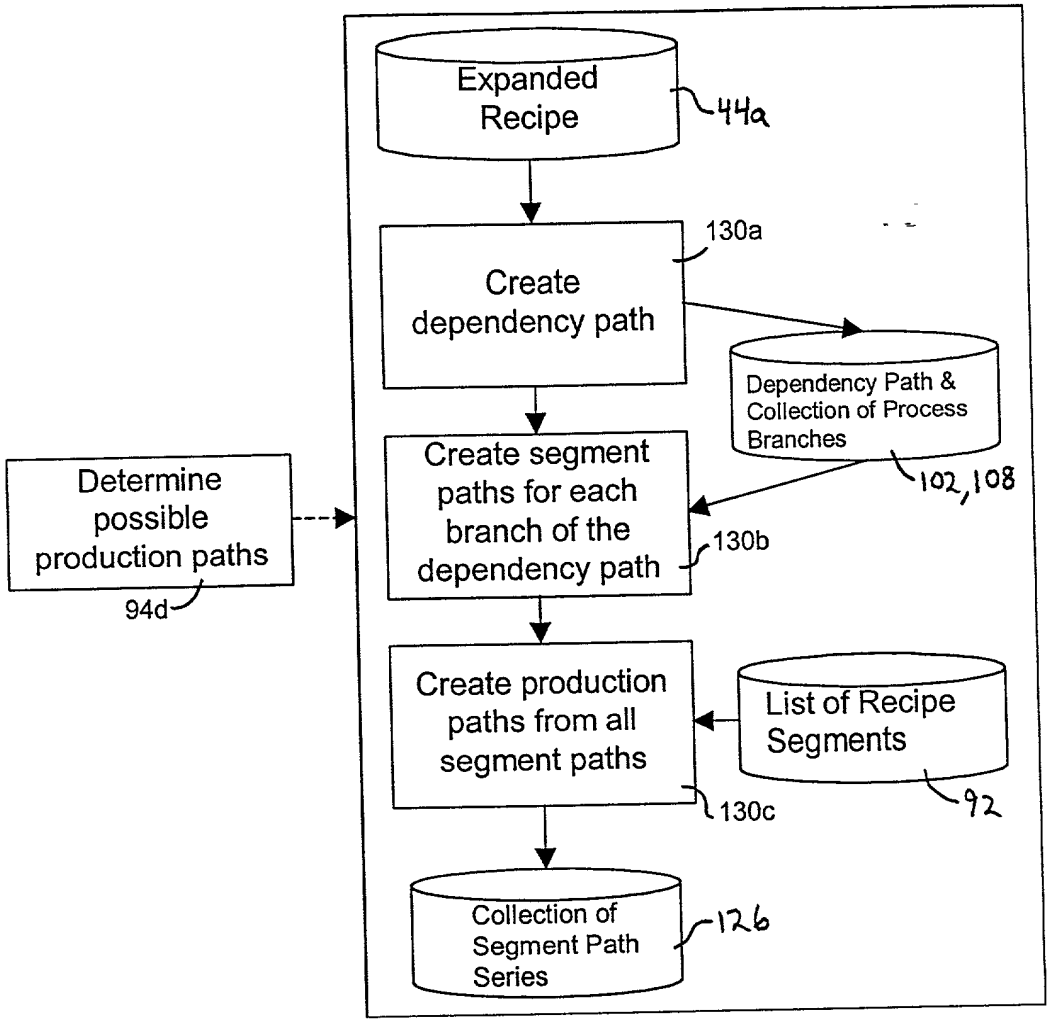
Expanded Recipe
44a
130a
Create dependency path
Dependency Path & Collection of Process Branches
102, 108
Determine possible production paths
94d
Create segment paths for each branch of the dependency path
130b
Create production paths from all segment paths
List of Recipe Segments
92
130c
Collection of Segment Path Series
126

Fig. 25

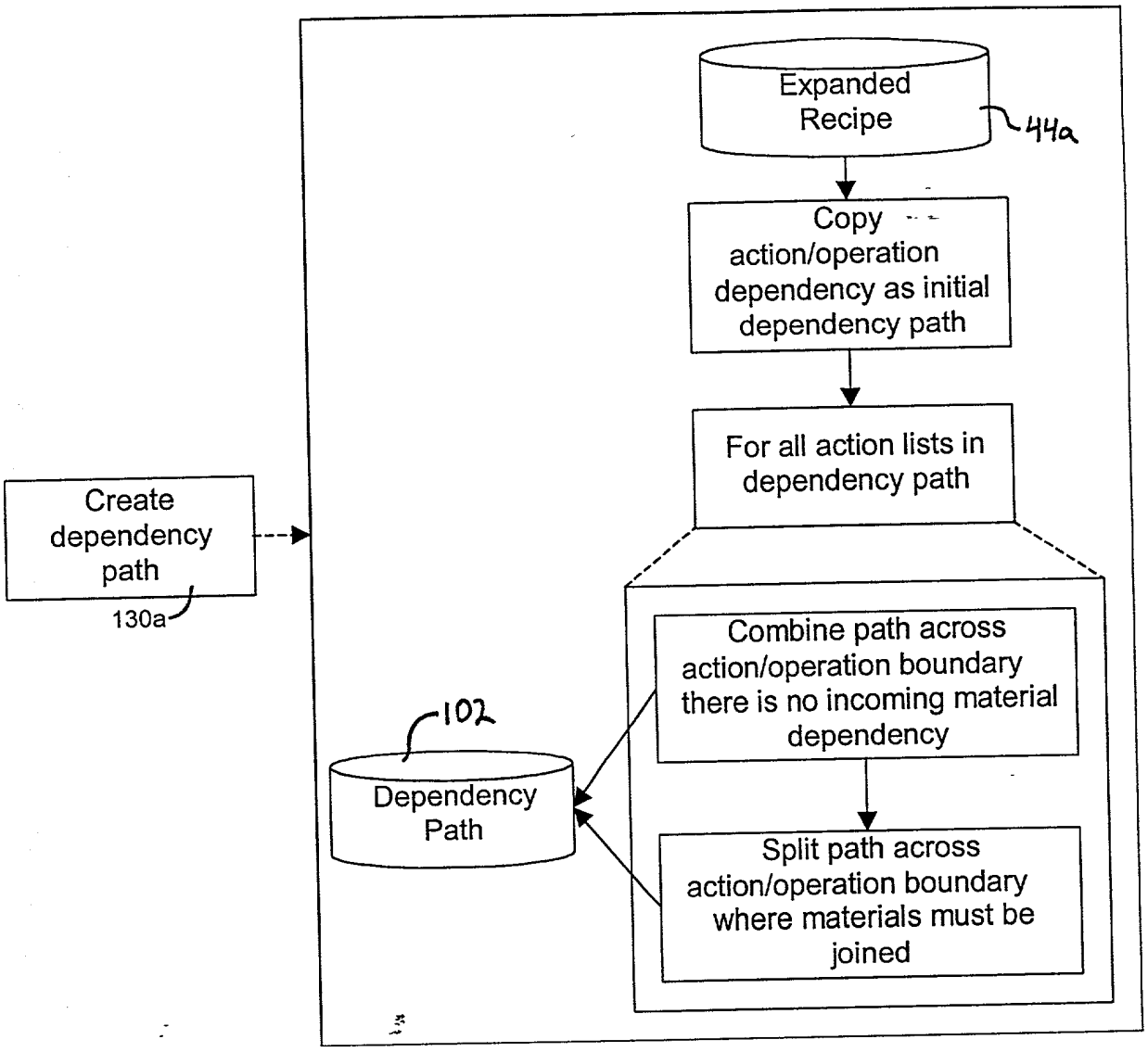
Expanded Recipe
44a
Copy action/operation dependency as initial dependency path
For all action lists in dependency path
Create dependency path
130a
Combine path across action/operation boundary there is no incoming material dependency
102
Dependency Path
Split path across action/operation boundary where materials must be joined

Fig. 26

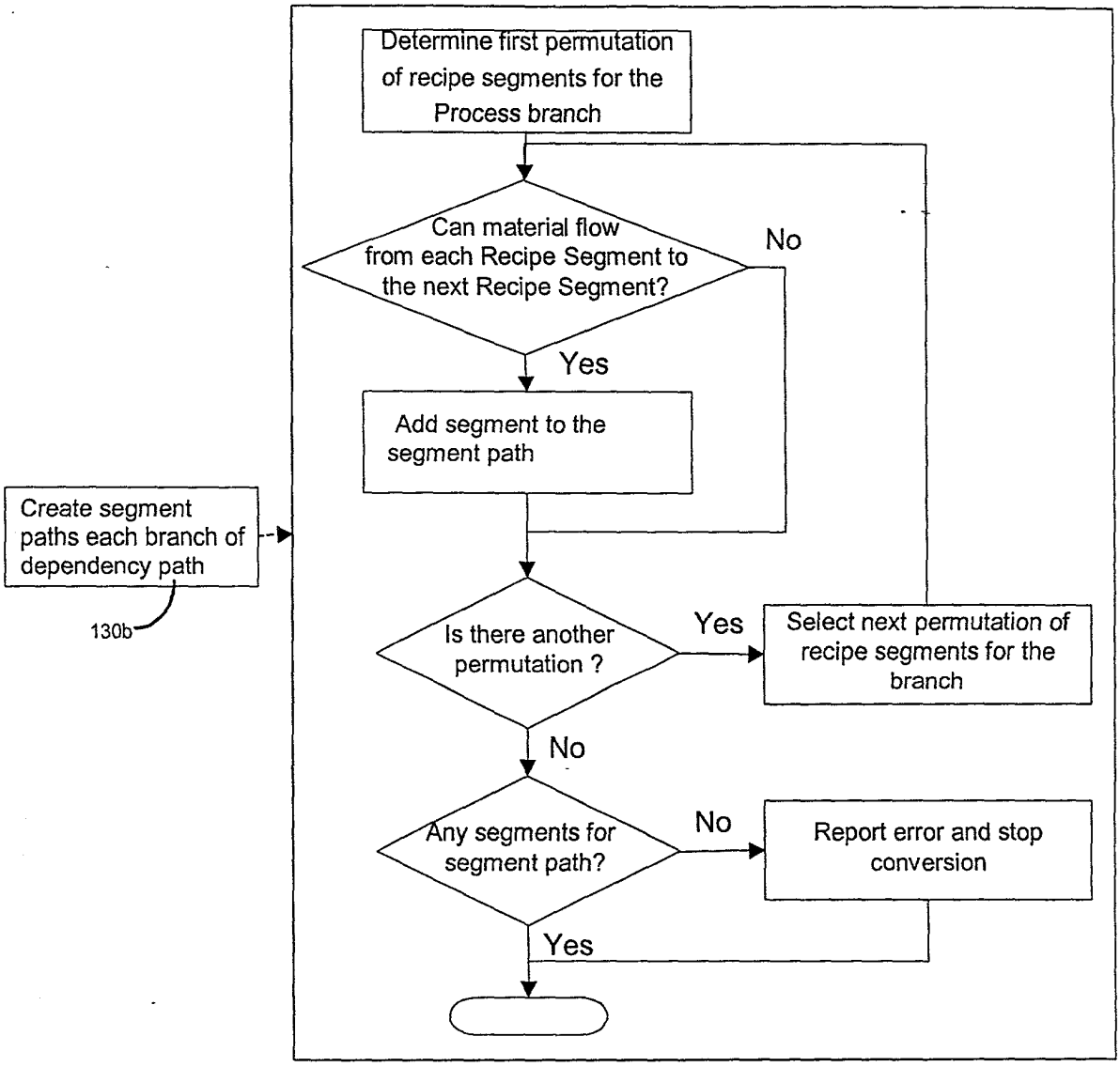
Determine first permutation of recipe segments for the Process branch
Can material flow from each Recipe Segment to the next Recipe Segment?
No
Yes
Add segment to the segment path
Create segment paths each branch of dependency path
130b
Is there another permutation ?
Yes
Select next permutation of recipe segments for the branch
No
Any segments for segment path?
No
Report error and stop conversion
Yes

Fig. 27

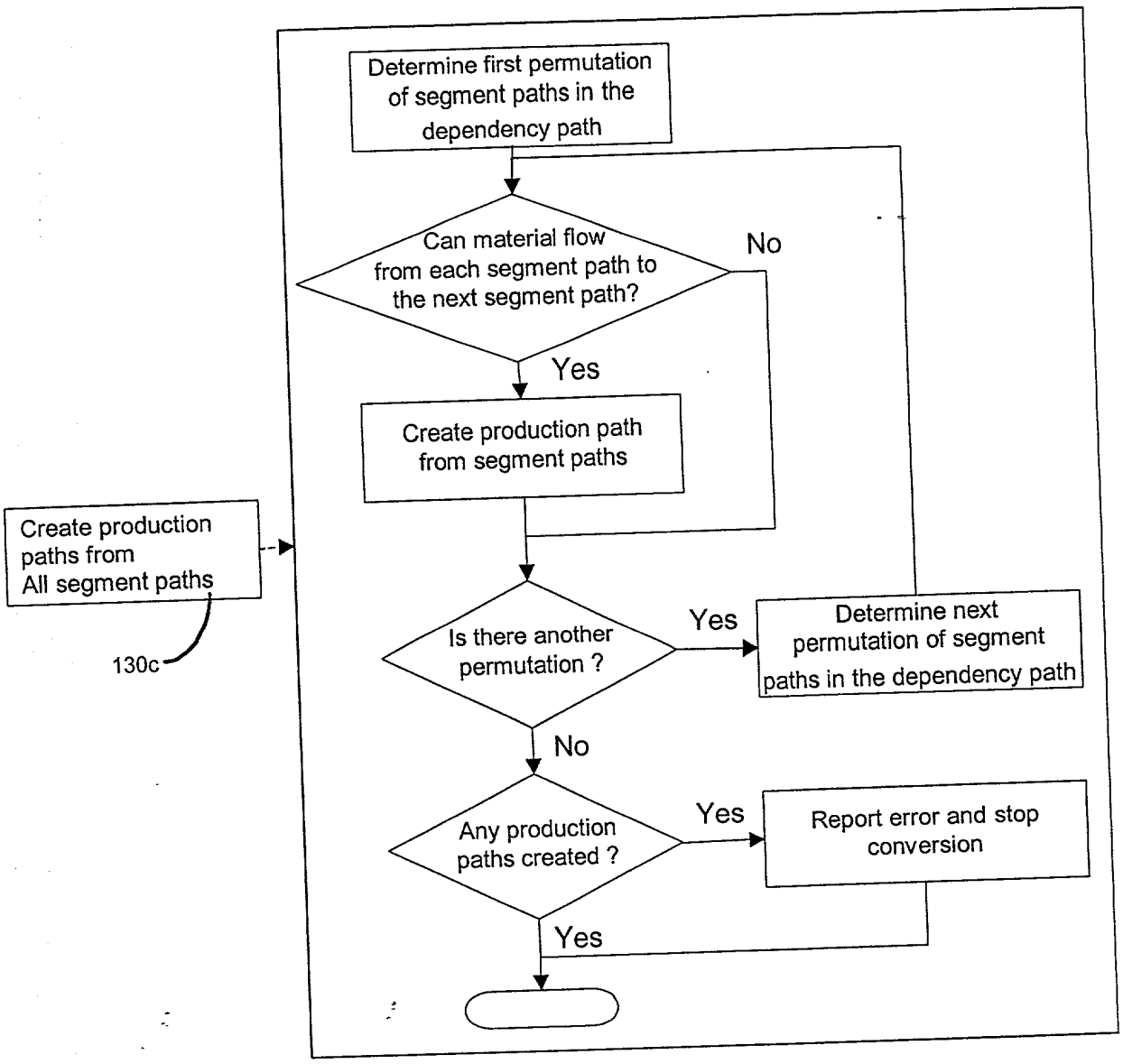
Create production paths from All segment paths
130c
Determine first permutation of segment paths in the dependency path
Can material flow from each segment path to the next segment path?
No
Yes
Create production path from segment paths
Is there another permutation ?
Yes
Determine next permutation of segment paths in the dependency path
No
Any production paths created ?
Yes
Report error and stop conversion
Yes

Fig. 28

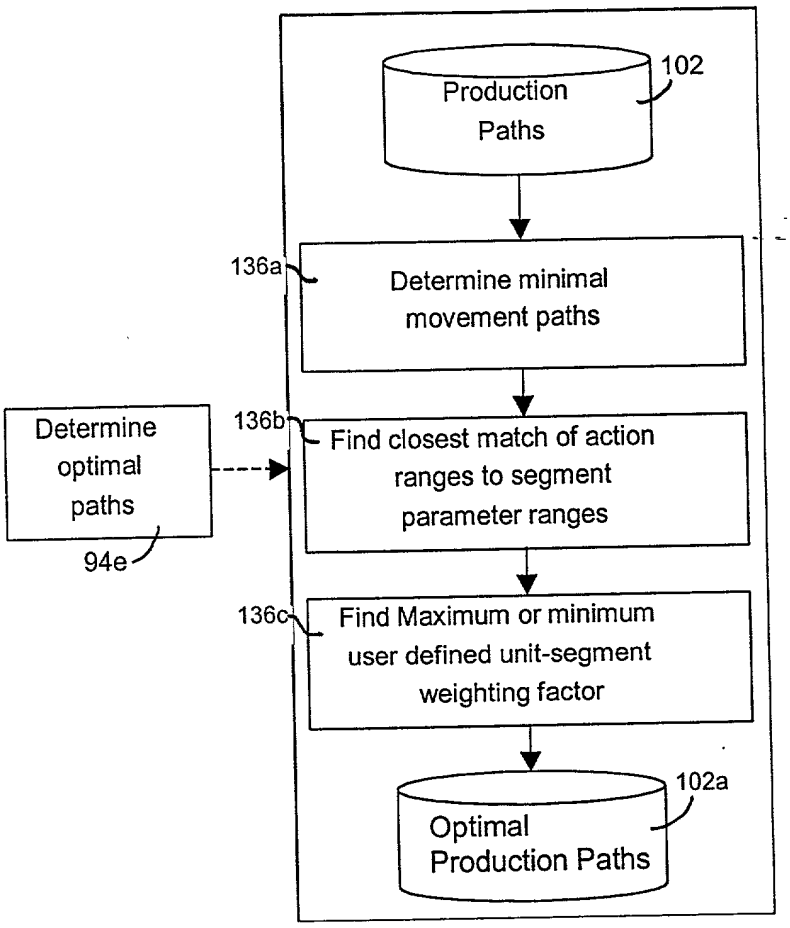
Production Paths
102
136a
Determine minimal movement paths
Determine optimal paths
94e
136b
Find closest match of action ranges to segment parameter ranges
136c
Find Maximum or minimum user defined unit-segment weighting factor
Optimal Production Paths
102a

Fig. 29

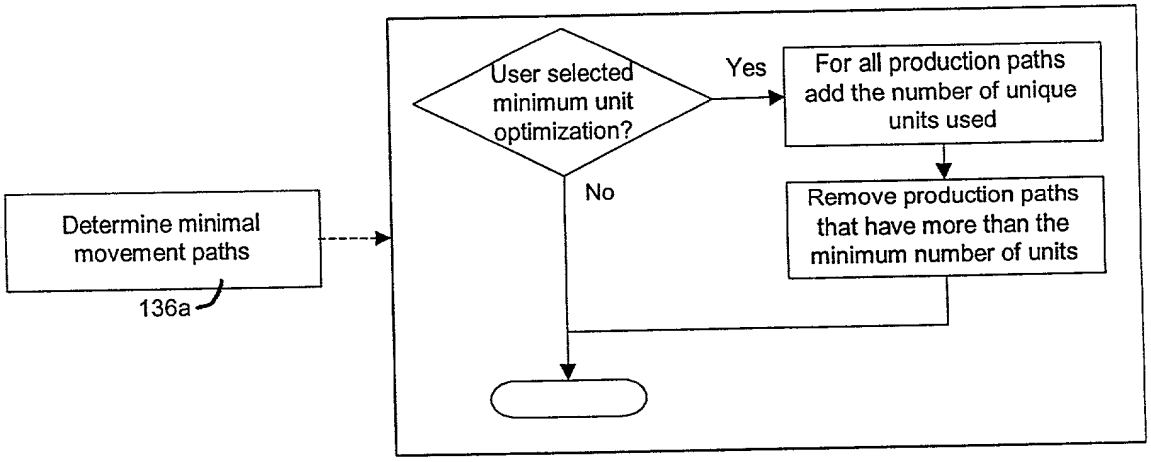
Determine minimal movement paths
136a
User selected minimum unit optimization?
Yes
No
For all production paths add the number of unique units used
Remove production paths that have more than the minimum number of units

Fig. 30

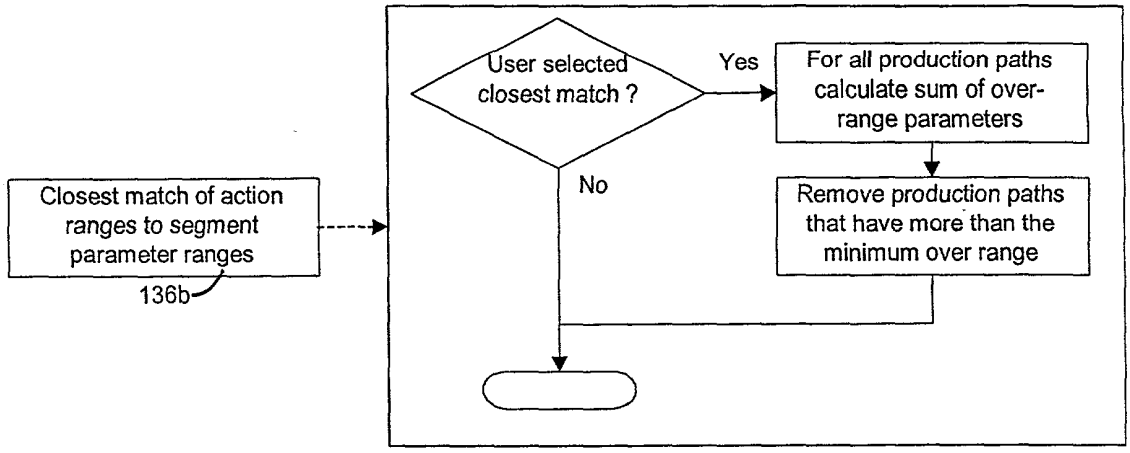
User selected closest match ?
Yes
For all production paths calculate sum of over-range parameters
No
Remove production paths that have more than the minimum over range
Closest match of action ranges to segment parameter ranges
136b

Fig. 31

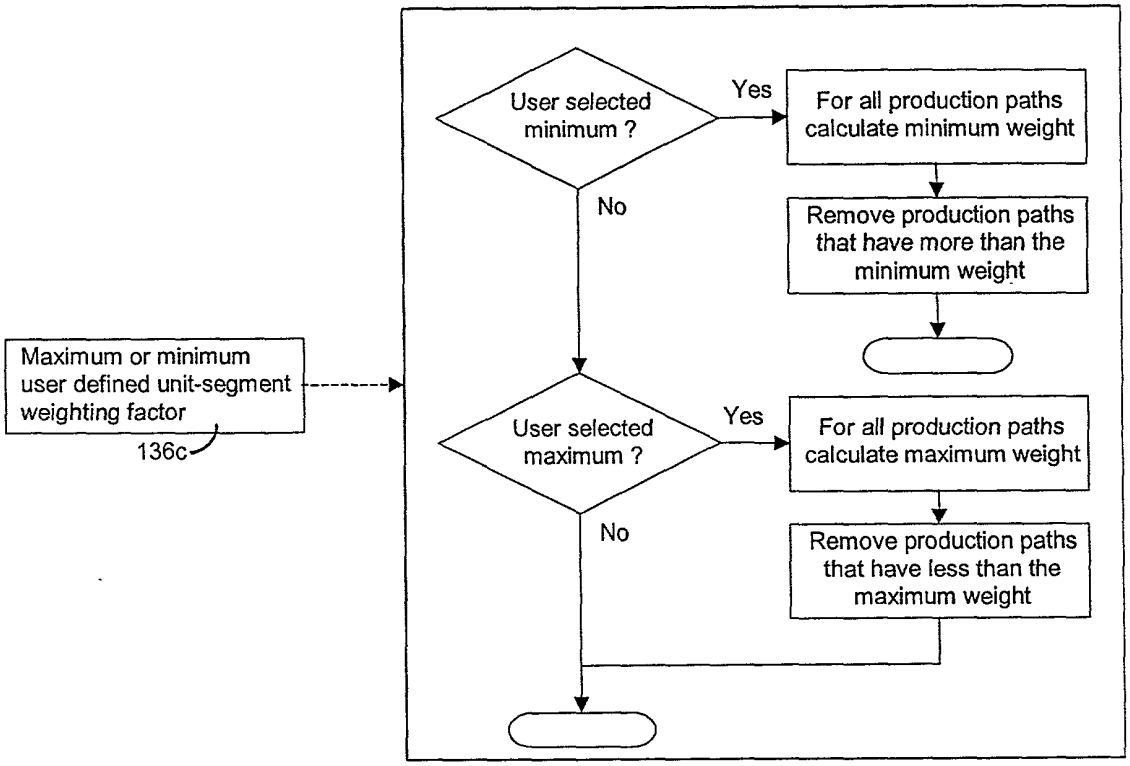
User selected minimum ?
Yes
For all production paths calculate minimum weight
No
Remove production paths that have more than the minimum weight
Maximum or minimum user defined unit-segment weighting factor
136c
User selected maximum ?
Yes
For all production paths calculate maximum weight
No
Remove production paths that have less than the maximum weight

Fig. 32

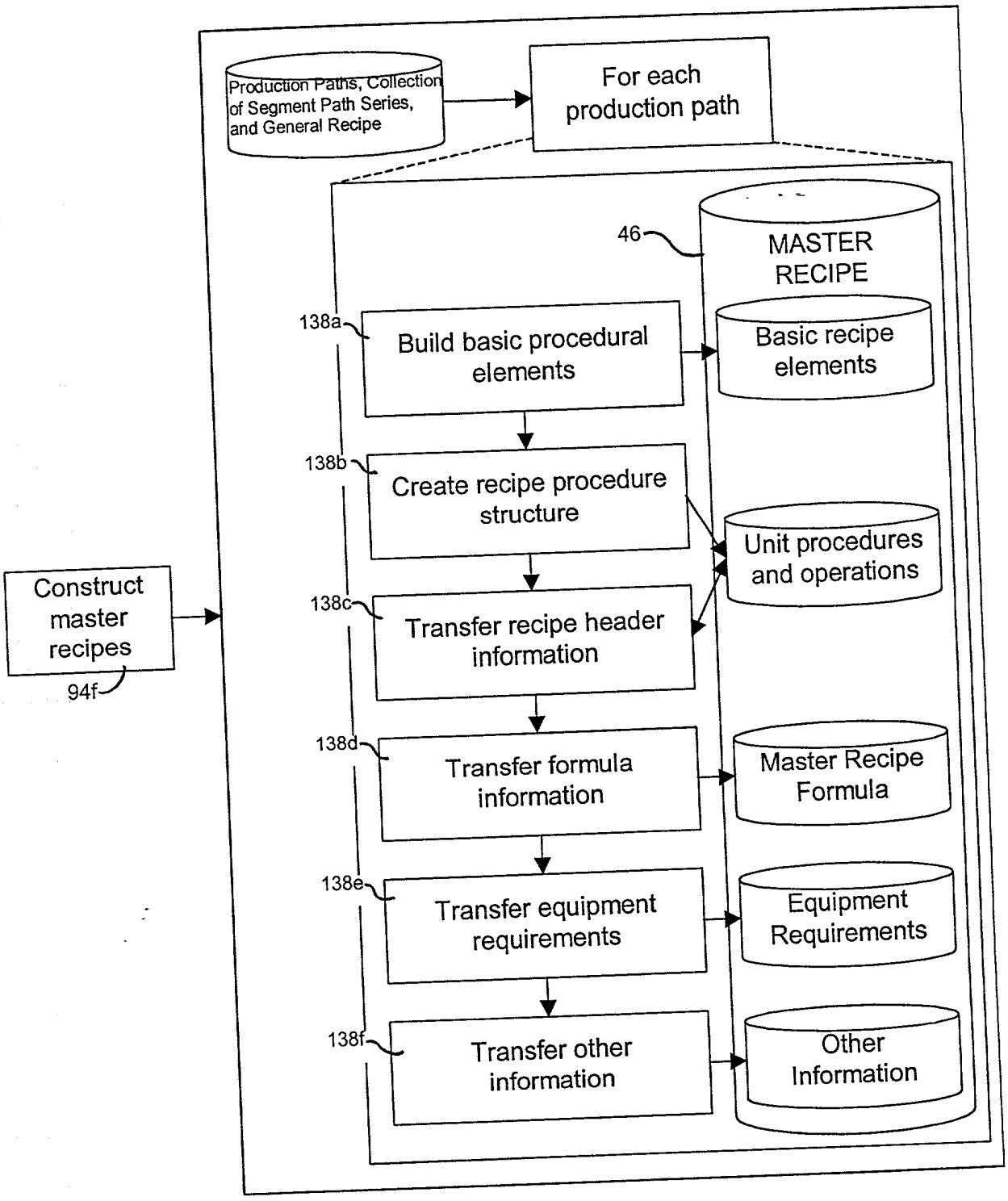
Production Paths, Collection of Segment Path Series, and General Recipe
For each production path
46
MASTER RECIPE
138a
Build basic procedural elements
Basic recipe elements
138b
Create recipe procedure structure
Unit procedures and operations
Construct master recipes
94f
138c
Transfer recipe header information
138d
Transfer formula information
Master Recipe Formula
138e
Transfer equipment requirements
Equipment Requirements
138f
Transfer other information
Other Information

Fig. 33

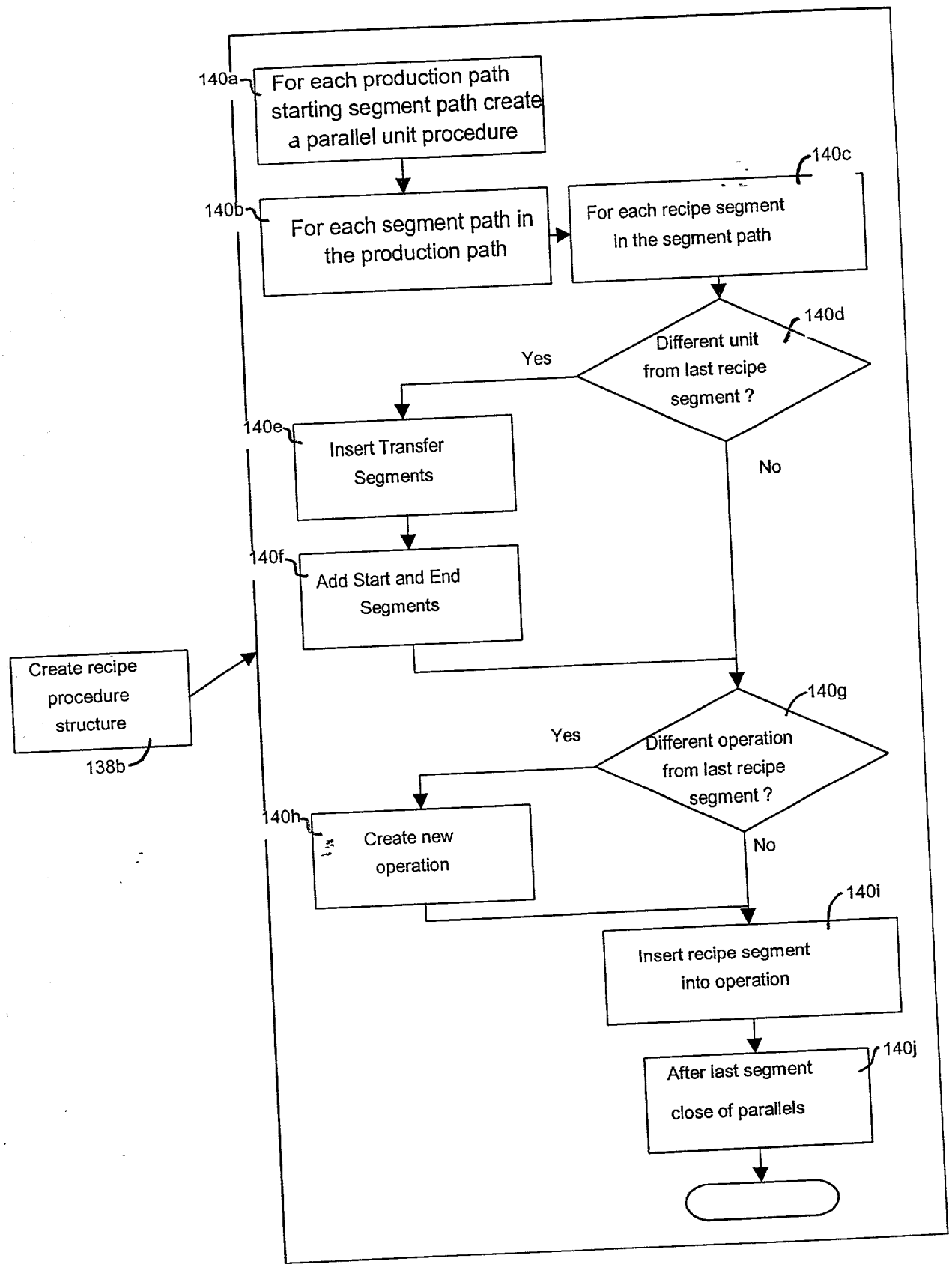
140a
For each production path starting segment path create a parallel unit procedure
140b
For each segment path in the production path
140c
For each recipe segment in the segment path
140d
Different unit from last recipe segment ?
Yes
No
140e
Insert Transfer Segments
140f
Add Start and End Segments
Create recipe procedure structure
138b
140g
Different operation from last recipe segment ?
Yes
No
140h
Create new operation
140i
Insert recipe segment into operation
140j
After last segment close of parallels

Fig. 34

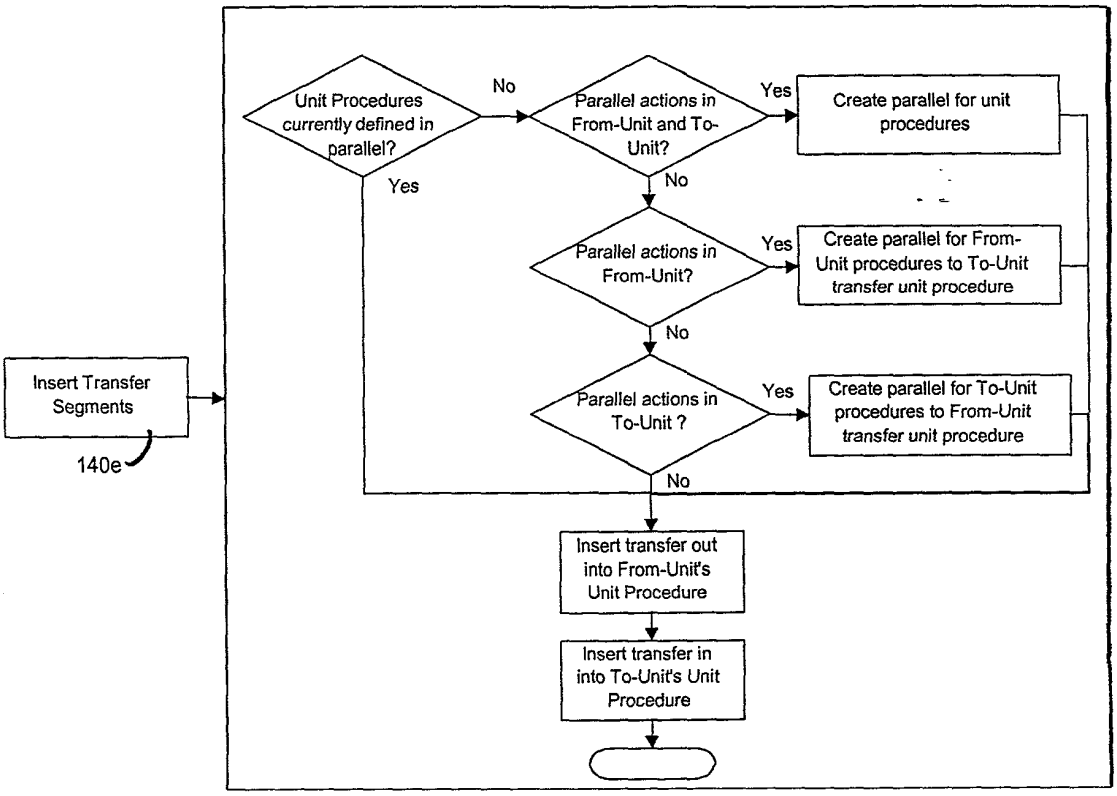
Insert Transfer Segments
140e
Unit Procedures currently defined in parallel?
No
Yes
Parallel actions in From-Unit and To-Unit?
Yes
Create parallel for unit procedures
No
Parallel actions in From-Unit?
Yes
Create parallel for From-Unit procedures to To-Unit transfer unit procedure
No
Parallel actions in To-Unit ?
Yes
Create parallel for To-Unit procedures to From-Unit transfer unit procedure
No
Insert transfer out into From-Unit's Unit Procedure
Insert transfer in into To-Unit's Unit Procedure

Fig. 35

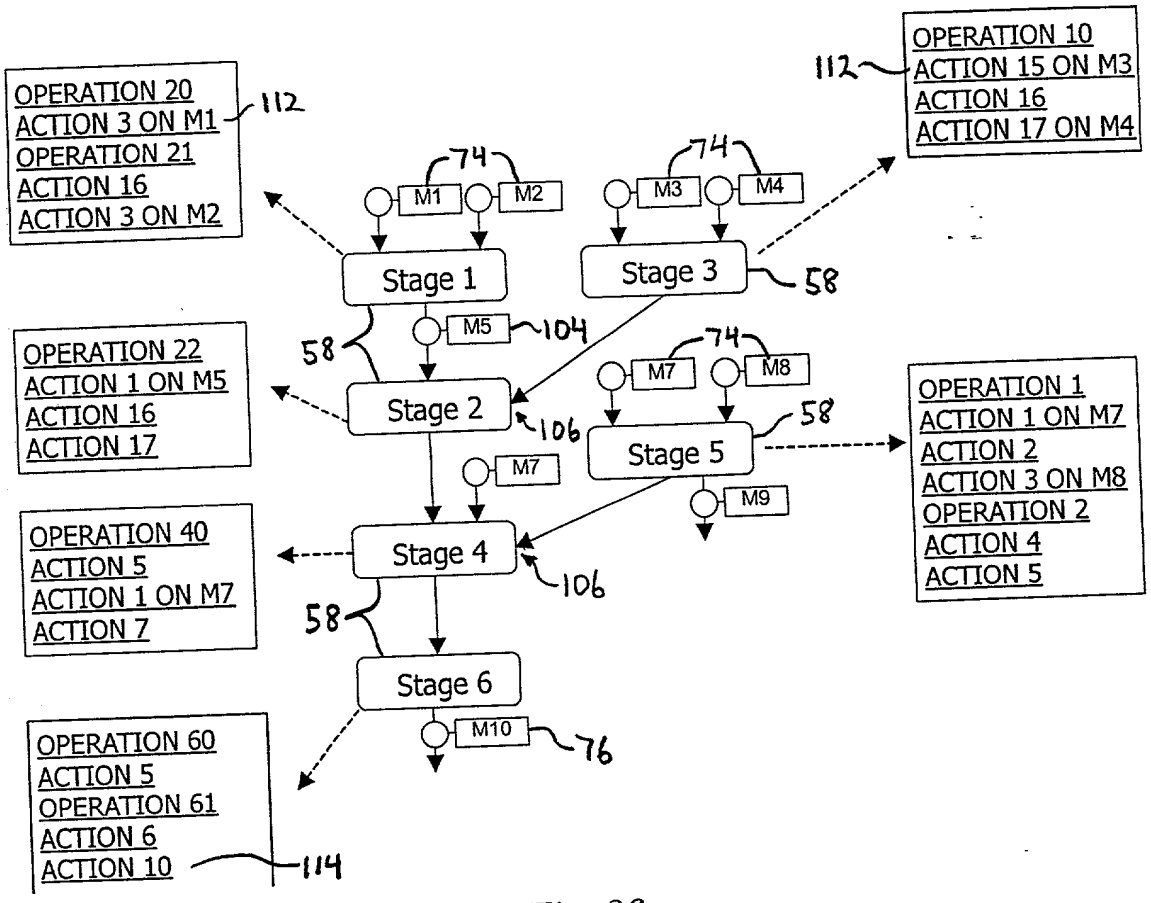
OPERATION 20
ACTION 3 ON M1
OPERATION 21
ACTION 16
ACTION 3 ON M2
112
74
M1
M2
74
M3
M4
OPERATION 10
ACTION 15 ON M3
ACTION 16
ACTION 17 ON M4
112
Stage 1
Stage 3
58
M5
104
58
OPERATION 22
ACTION 1 ON M5
ACTION 16
ACTION 17
74
M7
M8
Stage 2
106
58
Stage 5
OPERATION 1
ACTION 1 ON M7
ACTION 2
ACTION 3 ON M8
OPERATION 2
ACTION 4
ACTION 5
M7
M9
OPERATION 40
ACTION 5
ACTION 1 ON M7
ACTION 7
Stage 4
106
58
Stage 6
M10
76
OPERATION 60
ACTION 5
OPERATION 61
ACTION 6
ACTION 10
114

Fig. 36

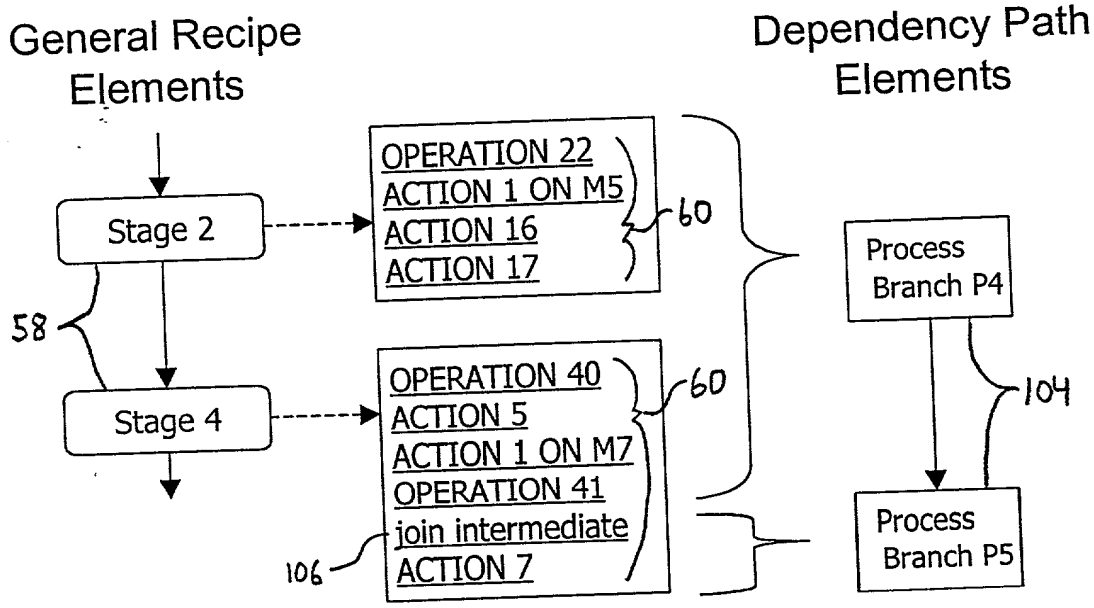
General Recipe Elements
Dependency Path Elements
Stage 2
58
Stage 4
OPERATION 22
ACTION 1 ON M5
ACTION 16
ACTION 17
60
OPERATION 40
ACTION 5
ACTION 1 ON M7
OPERATION 41
join intermediate
ACTION 7
60
106
Process Branch P4
104
Process Branch P5

Fig. 37

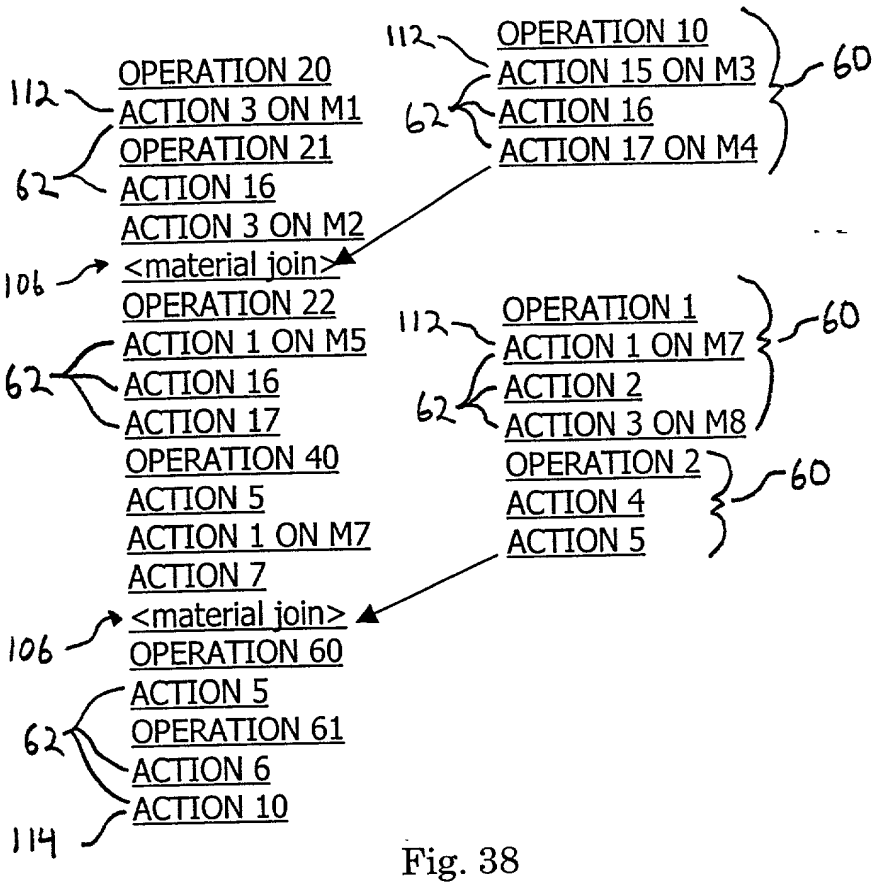
OPERATION 10
ACTION 15 ON M3
ACTION 16
ACTION 17 ON M4
60
112
62
OPERATION 20
ACTION 3 ON M1
OPERATION 21
ACTION 16
ACTION 3 ON M2
<material join>
106
OPERATION 22
ACTION 1 ON M5
ACTION 16
ACTION 17
OPERATION 40
ACTION 5
ACTION 1 ON M7
ACTION 7
<material join>
106
OPERATION 60
ACTION 5
OPERATION 61
ACTION 6
ACTION 10
114
OPERATION 1
ACTION 1 ON M7
ACTION 2
ACTION 3 ON M8
OPERATION 2
ACTION 4
ACTION 5

Fig. 38

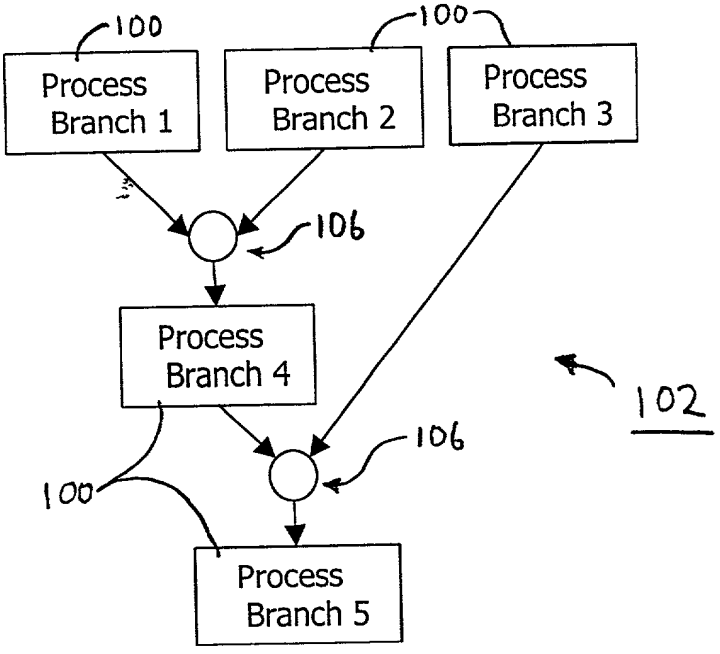
Process Branch 1
Process Branch 2
Process Branch 3
Process Branch 4
Process Branch 5
100
106
102

Fig. 39

From Element	To Element	From Type	To Type
Path 1	Join 1	Path	Join
Path 2	Join 1	Path	Join
Join 1	Path 4	Join	Path
Path 3	Join 2	Path	Join
Path 4	Join 2	Path	Join
Join 2	Path 5	Join	Path

Fig. 40

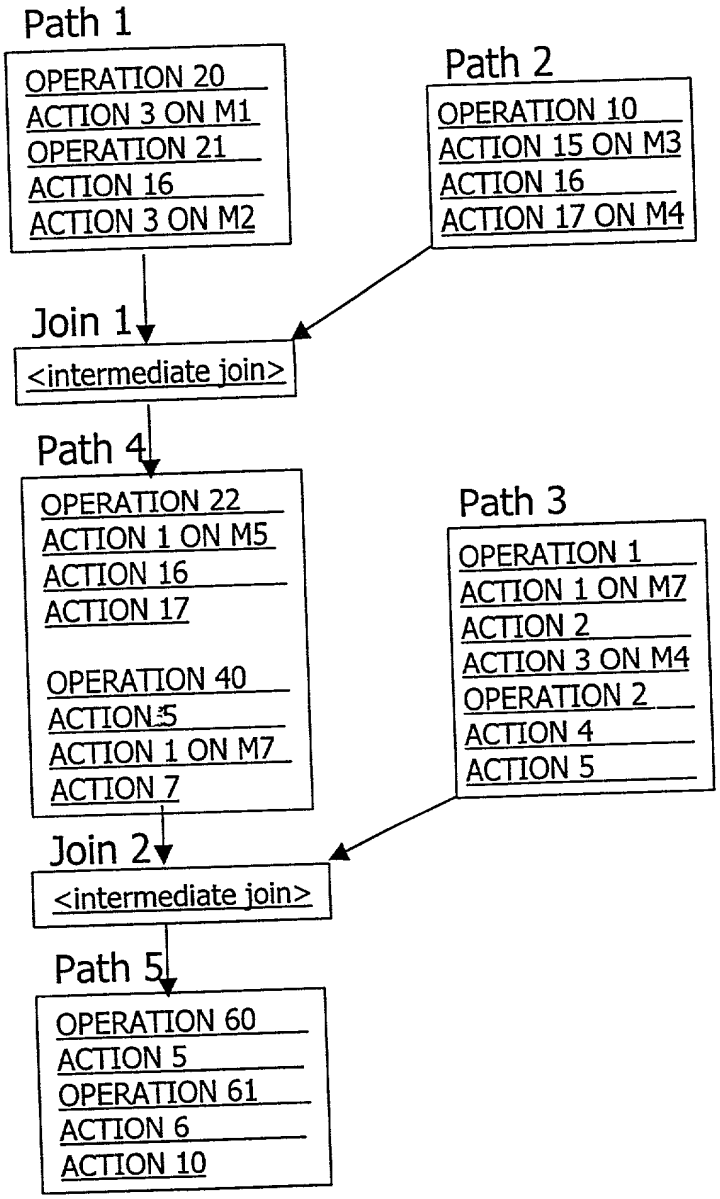

Fig. 41

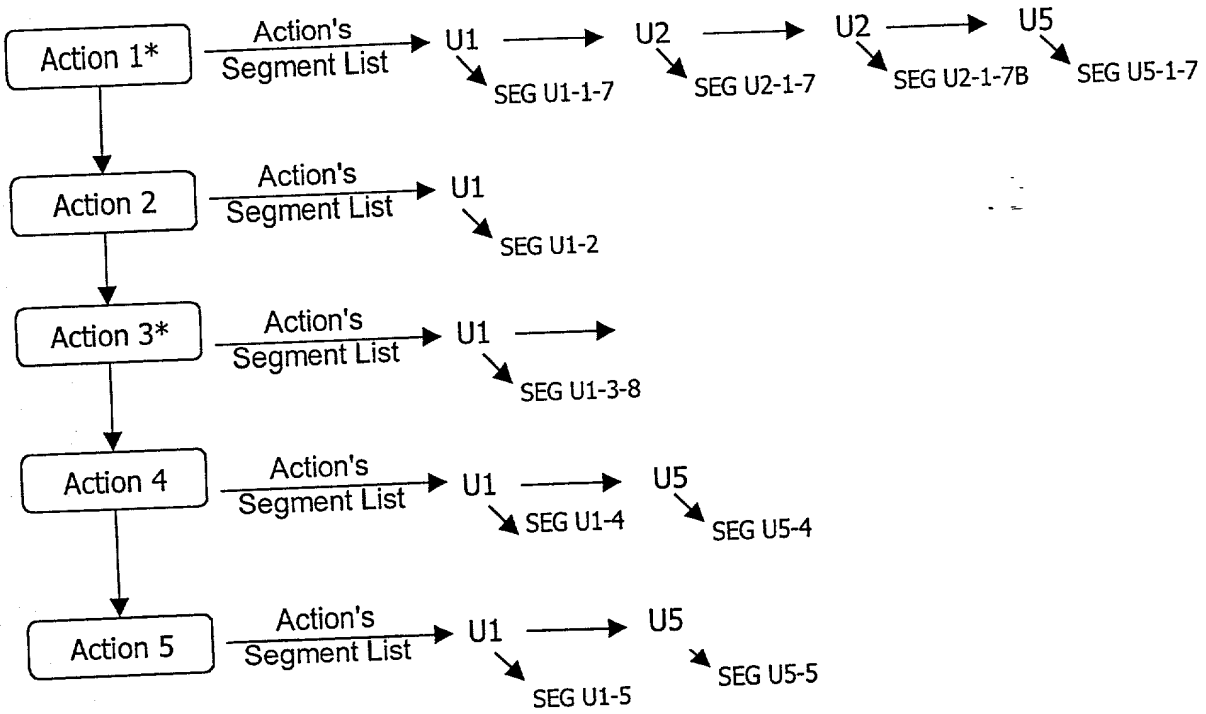
Action 1*
Action's Segment List
U1
SEG U1-1-7
U2
SEG U2-1-7
U2
SEG U2-1-7B
U5
SEG U5-1-7
Action 2
Action's Segment List
U1
SEG U1-2
Action 3*
Action's Segment List
U1
SEG U1-3-8
Action 4
Action's Segment List
U1
SEG U1-4
U5
SEG U5-4
Action 5
Action's Segment List
U1
SEG U1-5
U5
SEG U5-5

Fig. 42

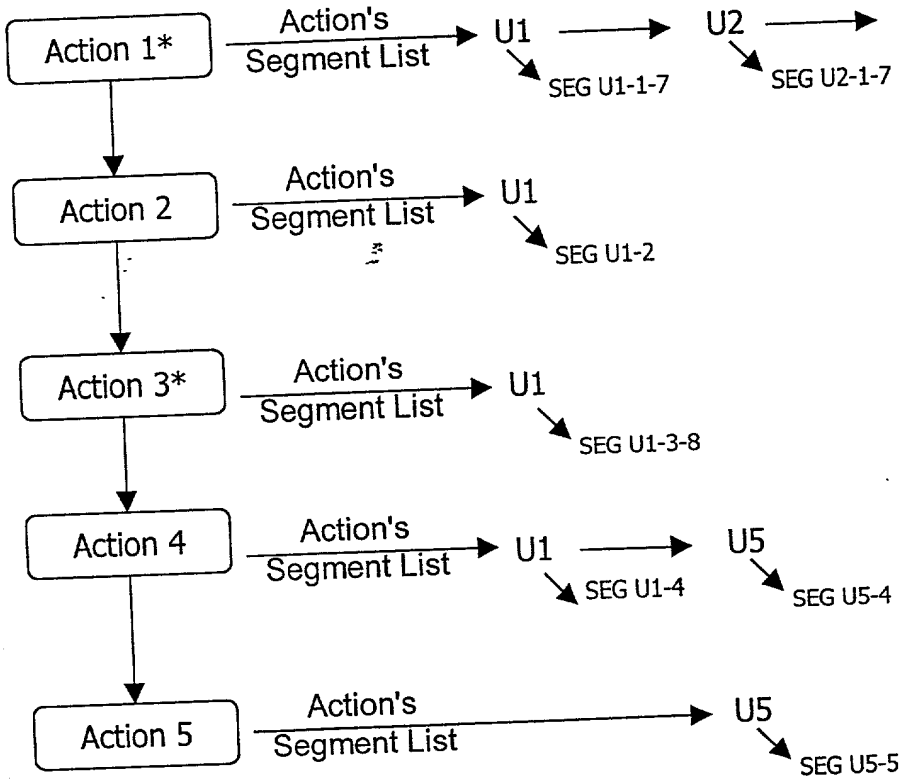
Action 1*
Action's Segment List
U1
SEG U1-1-7
U2
SEG U2-1-7
Action 2
Action's Segment List
U1
SEG U1-2
Action 3*
Action's Segment List
U1
SEG U1-3-8
Action 4
Action's Segment List
U1
SEG U1-4
U5
SEG U5-4
Action 5
Action's Segment List
U5
SEG U5-5

Fig. 43

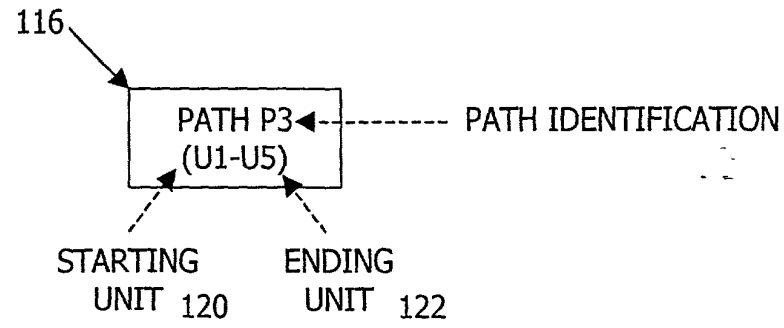

Fig. 44

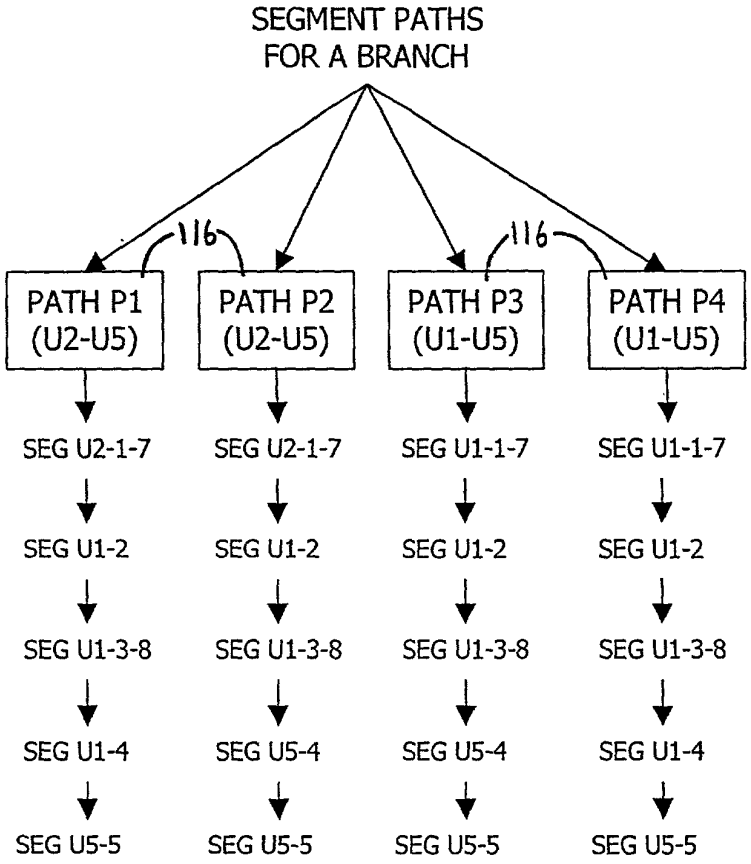

Fig. 45

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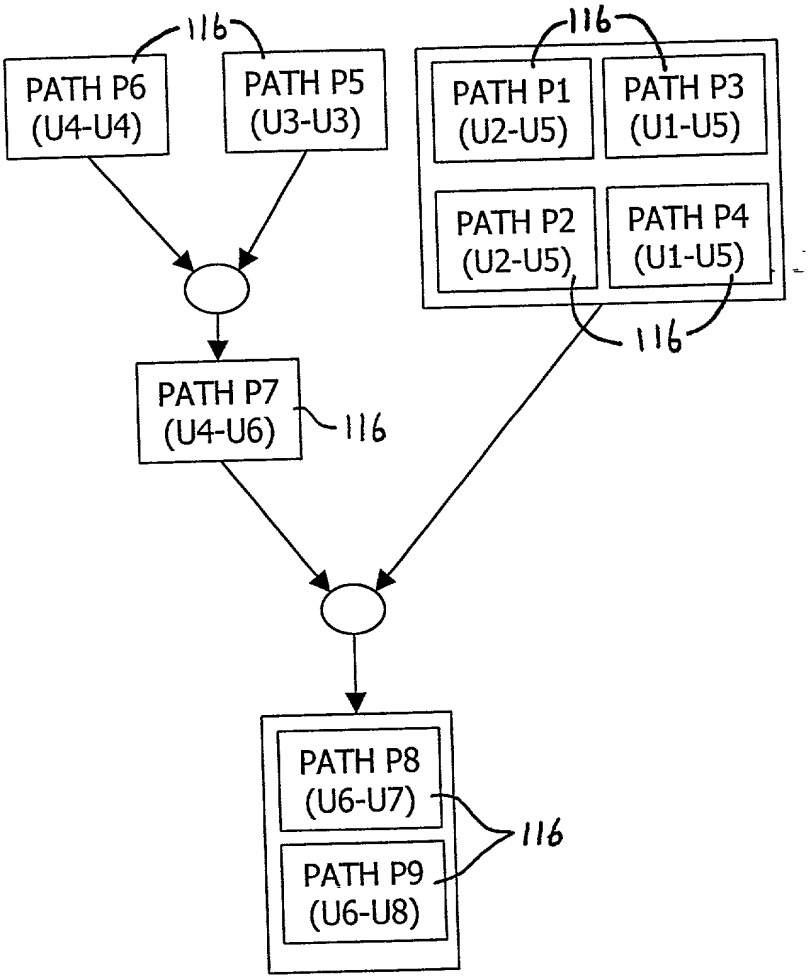

116
PATH P6
(U4-U4)
PATH P5
(U3-U3)
116
PATH P1
(U2-U5)
PATH P3
(U1-U5)
PATH P2
(U2-U5)
PATH P4
(U1-U5)
116
PATH P7
(U4-U6)
116
PATH P8
(U6-U7)
PATH P9
(U6-U8)
116

Fig. 46

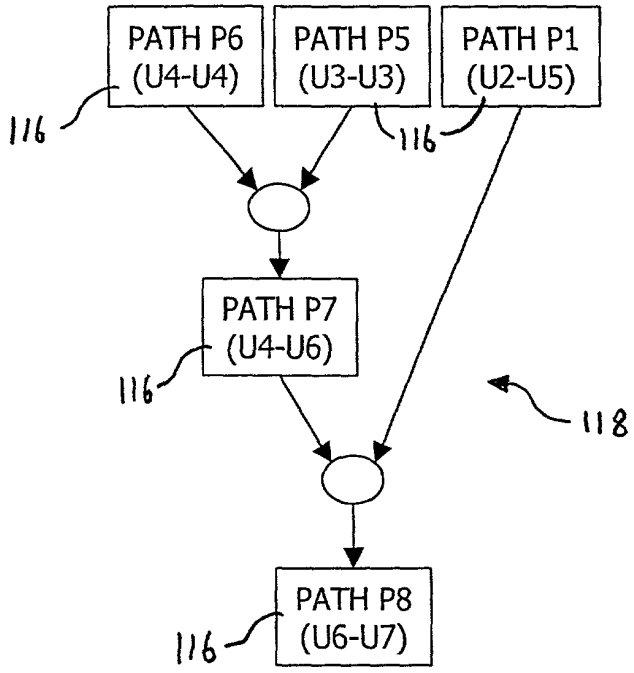

PATH P6
(U4-U4)
PATH P5
(U3-U3)
PATH P1
(U2-U5)
116
116
PATH P7
(U4-U6)
116
118
PATH P8
(U6-U7)
116

Fig. 47

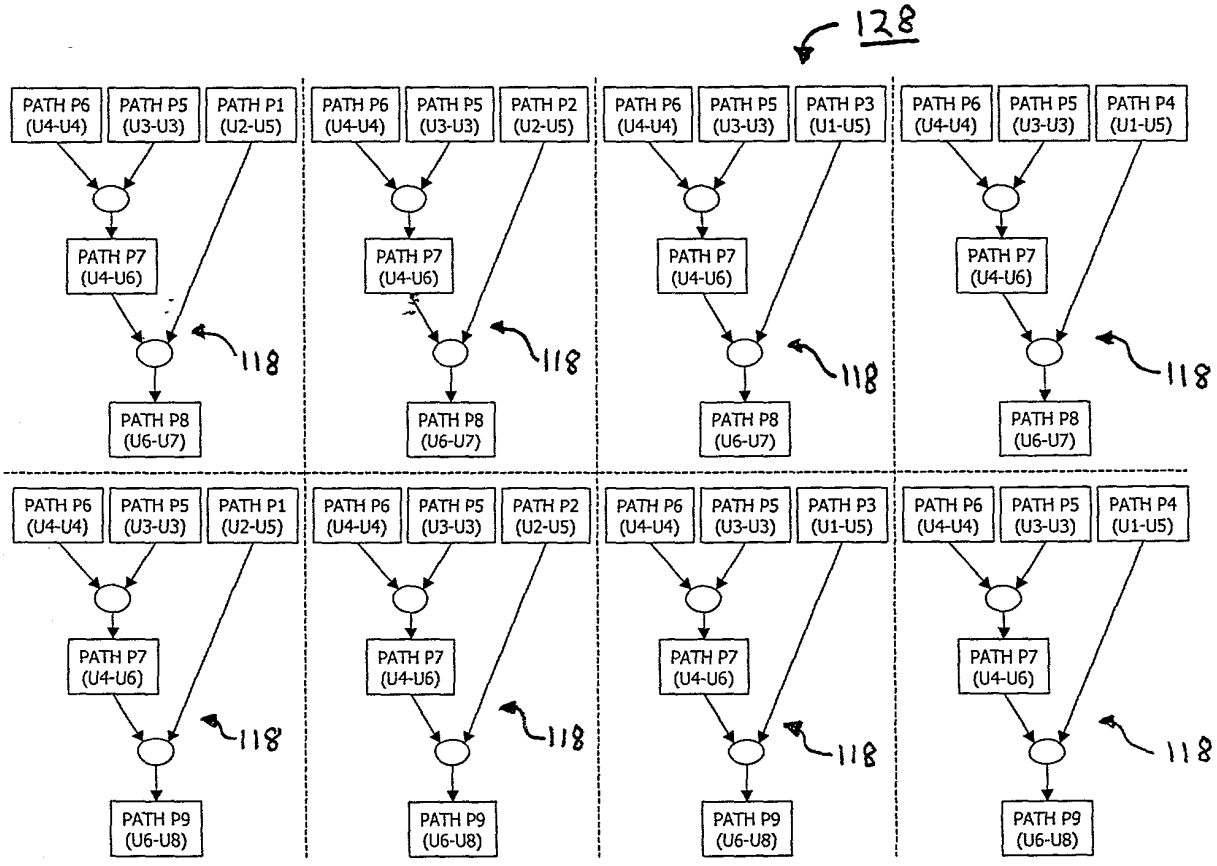

128
PATH P6 (U4-U4)
PATH P5 (U3-U3)
PATH P1 (U2-U5)
PATH P7 (U4-U6)
118
PATH P8 (U6-U7)
PATH P6 (U4-U4)
PATH P5 (U3-U3)
PATH P2 (U2-U5)
PATH P7 (U4-U6)
118
PATH P8 (U6-U7)
PATH P6 (U4-U4)
PATH P5 (U3-U3)
PATH P3 (U1-U5)
PATH P7 (U4-U6)
118
PATH P8 (U6-U7)
PATH P6 (U4-U4)
PATH P5 (U3-U3)
PATH P4 (U1-U5)
PATH P7 (U4-U6)
118
PATH P8 (U6-U7)
PATH P6 (U4-U4)
PATH P5 (U3-U3)
PATH P1 (U2-U5)
PATH P7 (U4-U6)
118
PATH P9 (U6-U8)
PATH P6 (U4-U4)
PATH P5 (U3-U3)
PATH P2 (U2-U5)
PATH P7 (U4-U6)
118
PATH P9 (U6-U8)
PATH P6 (U4-U4)
PATH P5 (U3-U3)
PATH P3 (U1-U5)
PATH P7 (U4-U6)
118
PATH P9 (U6-U8)
PATH P6 (U4-U4)
PATH P5 (U3-U3)
PATH P4 (U1-U5)
PATH P7 (U4-U6)
118
PATH P9 (U6-U8)

Fig. 48

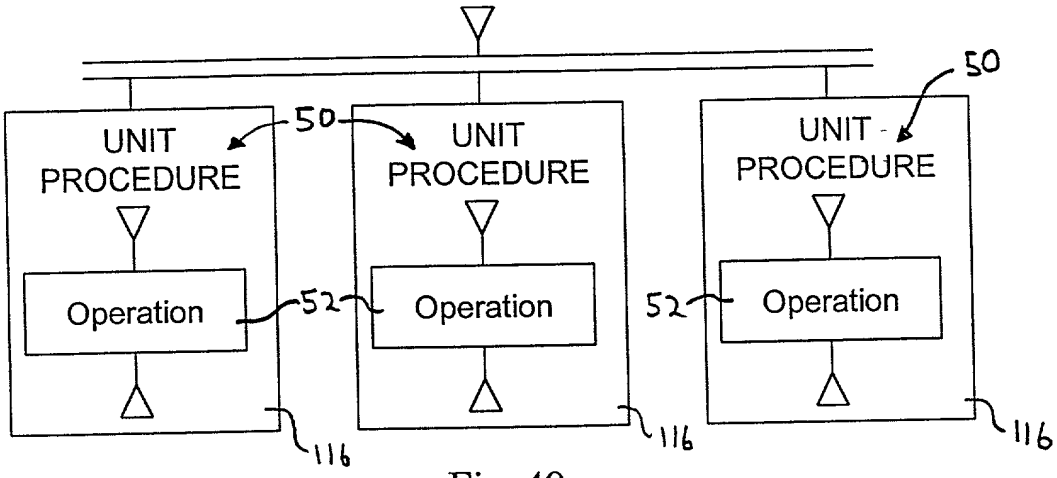


Fig. 49

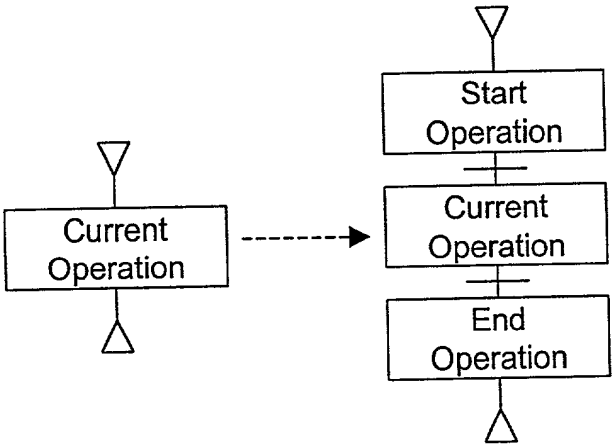


Fig. 50

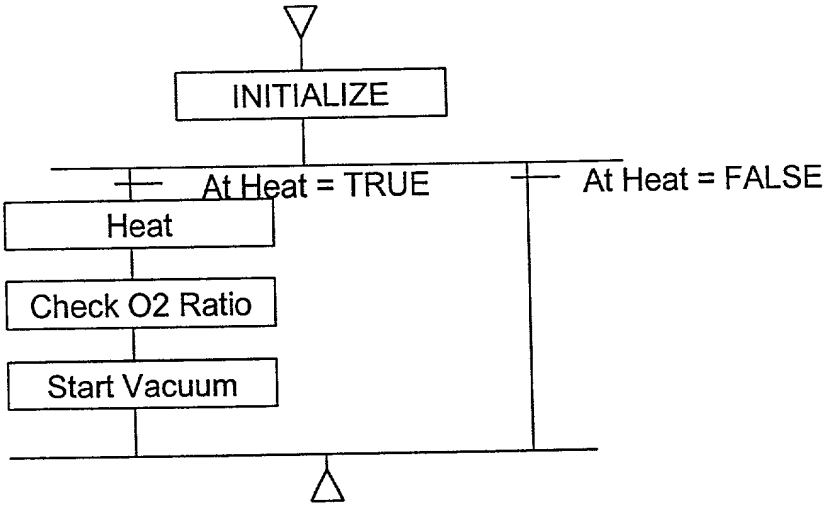


Fig. 51

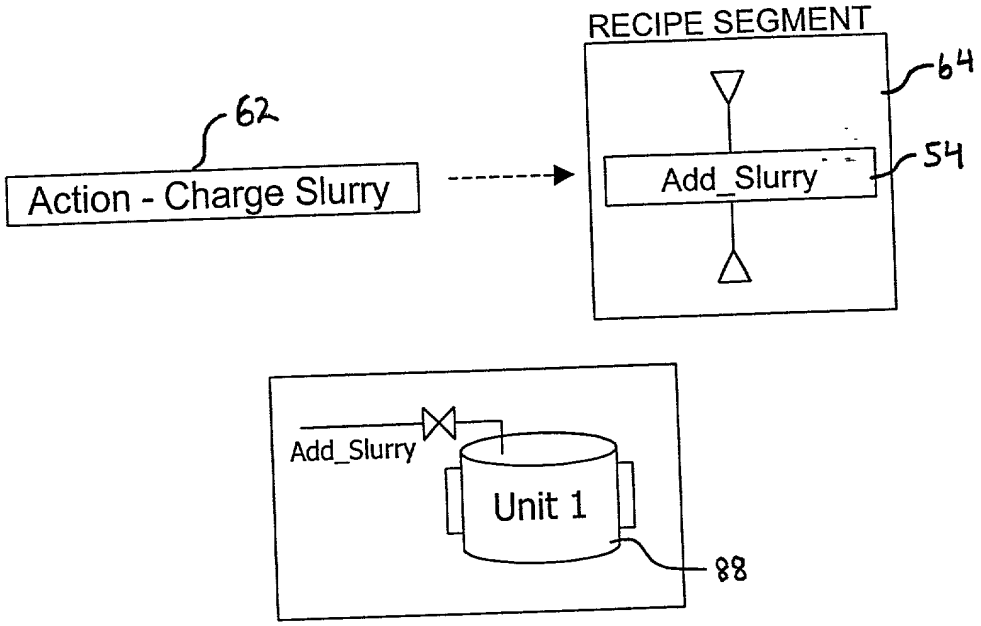

RECIPE SEGMENT
64
62
Action - Charge Slurry
Add_Slurry
54
Add_Slurry
Unit 1
88

Fig. 52

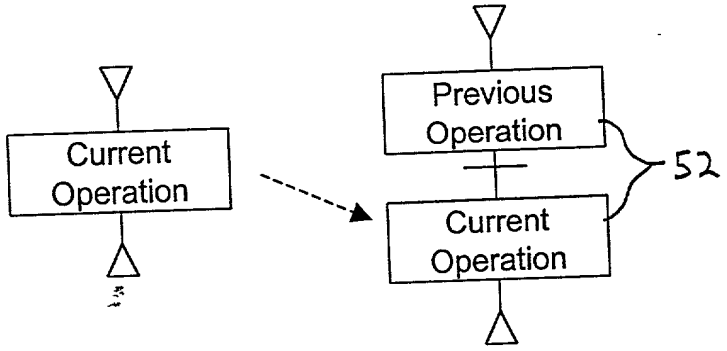

Previous Operation
Current Operation
52
Current Operation

Fig. 53

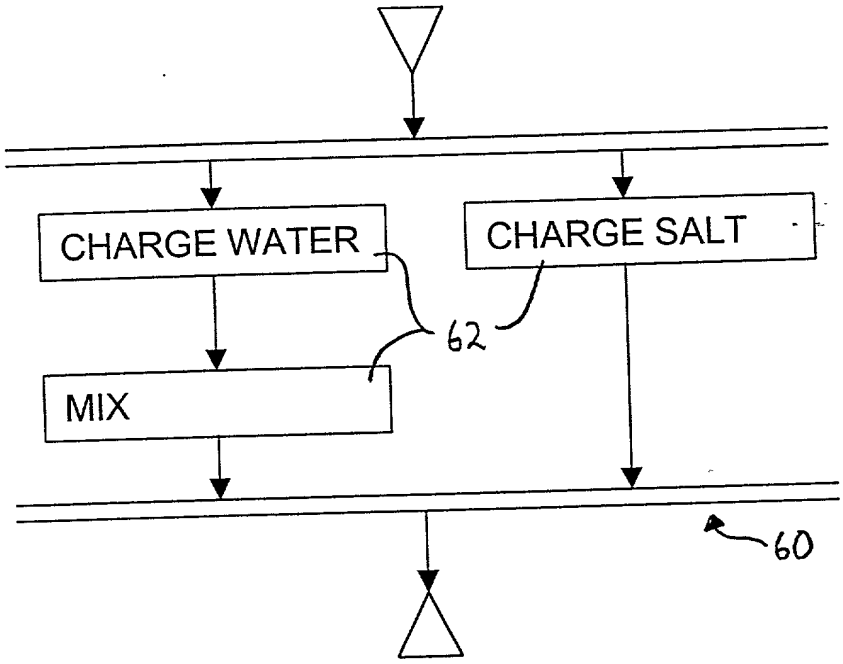


Fig. 54

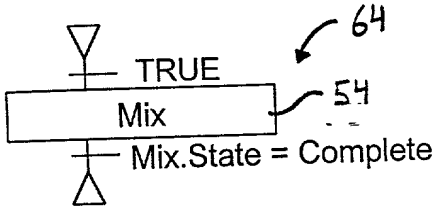
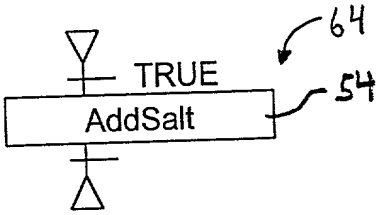
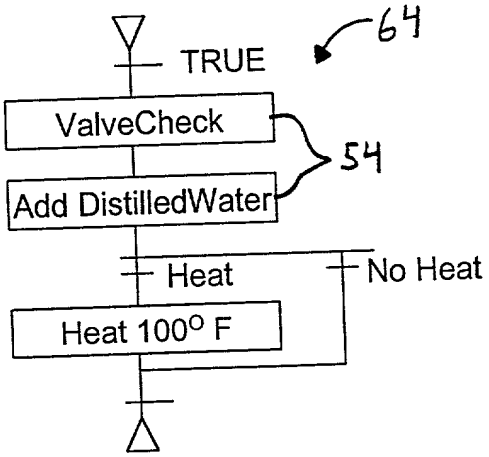
PROCESS ACTION	RECIPE SEGMENT
MIX	
CHARGE SALT	
CHARGE WATER	

Fig. 55

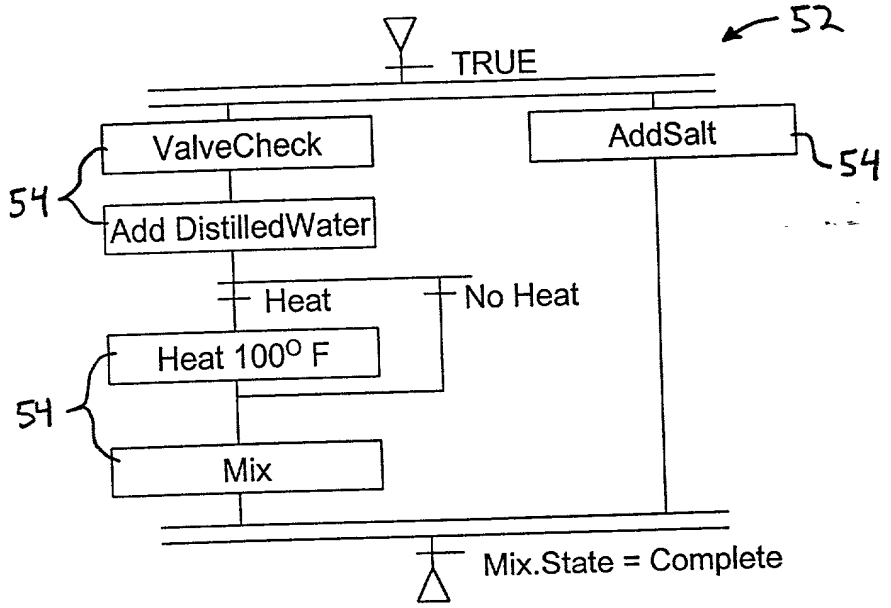

52
TRUE
ValveCheck
AddSalt
54
54
Add DistilledWater
Heat
No Heat
Heat 100° F
54
Mix
Mix.State = Complete

Fig. 56

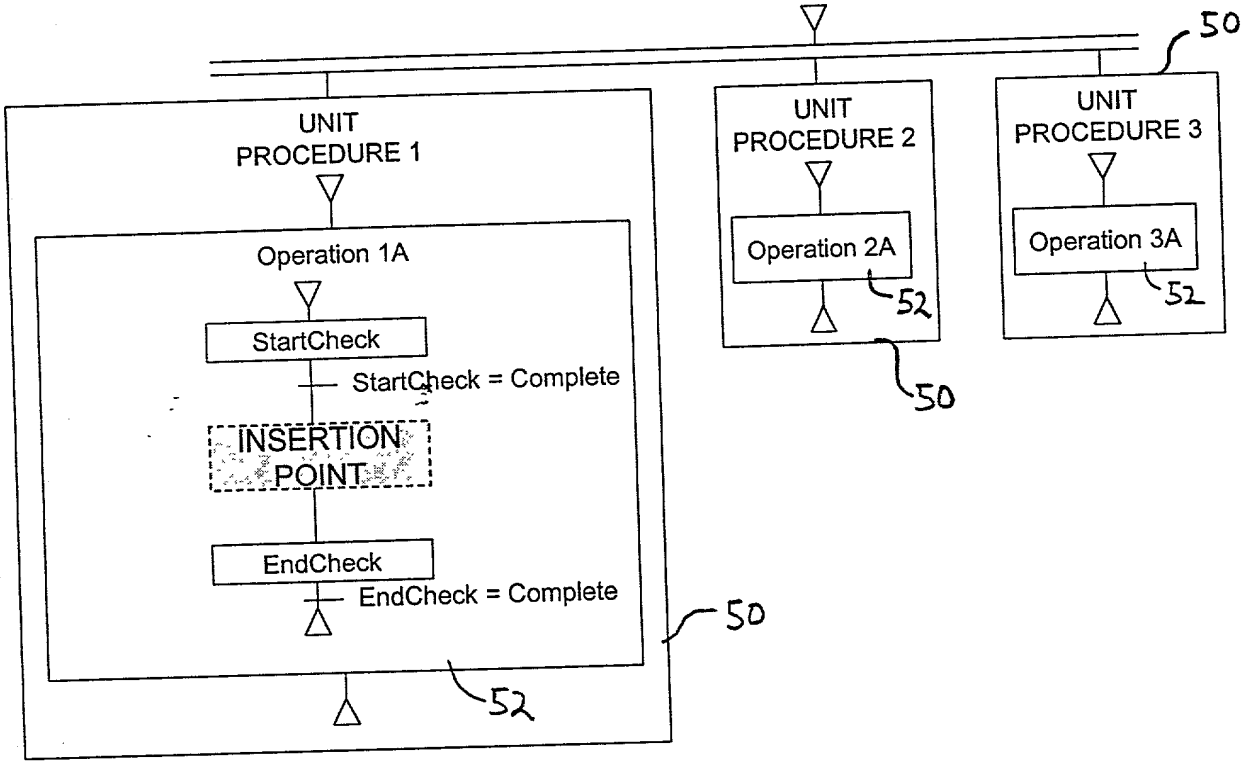

50
UNIT
PROCEDURE 1
UNIT
PROCEDURE 2
UNIT
PROCEDURE 3
Operation 1A
Operation 2A
Operation 3A
52
52
StartCheck
StartCheck = Complete
INSERTION
POINT
EndCheck
EndCheck = Complete
50
50
52

Fig. 57

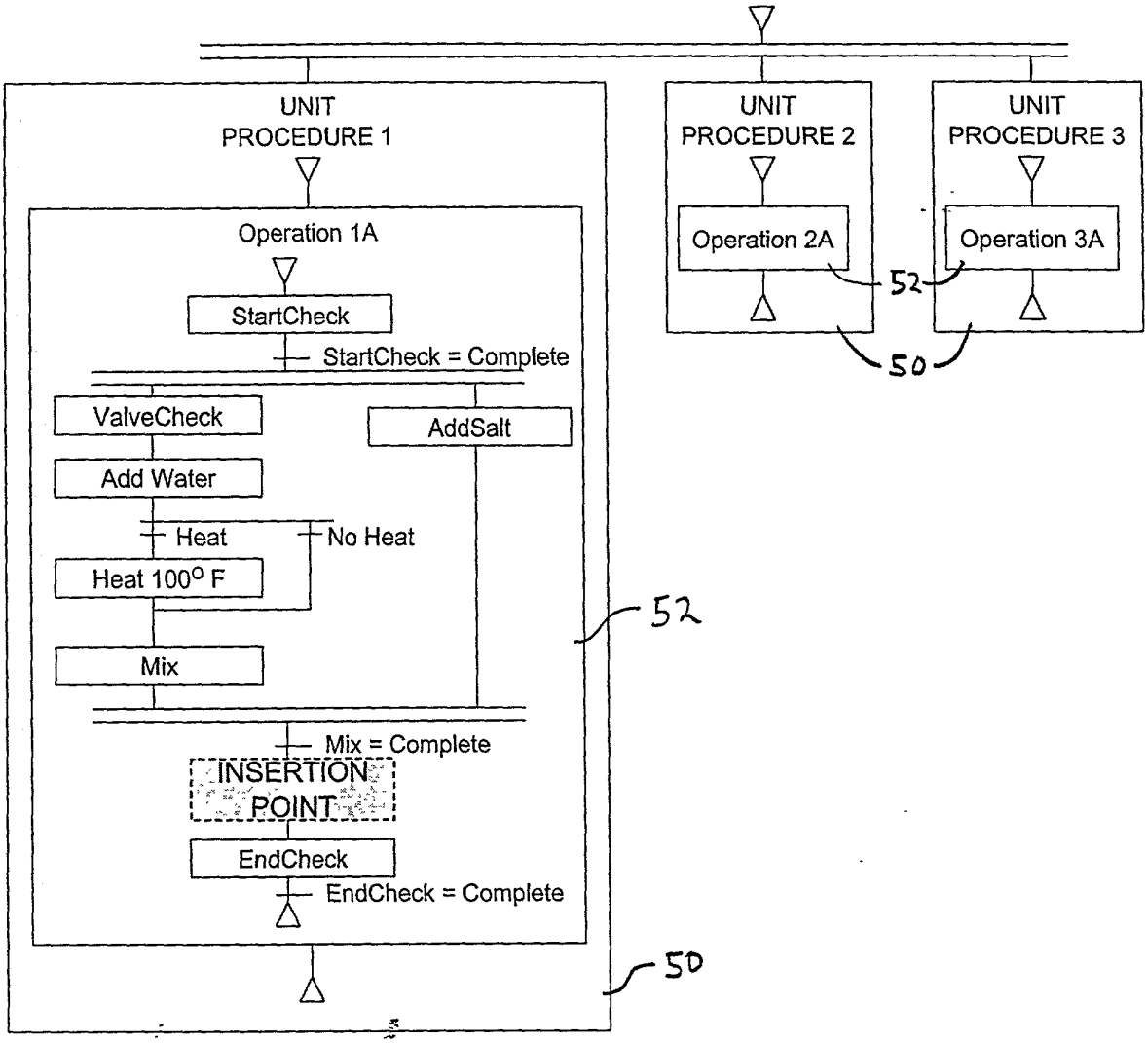

UNIT
PROCEDURE 1
Operation 1A
StartCheck
StartCheck = Complete
ValveCheck
AddSalt
Add Water
Heat
No Heat
Heat 100° F
Mix
Mix = Complete
INSERTION
POINT
EndCheck
EndCheck = Complete
UNIT
PROCEDURE 2
Operation 2A
UNIT
PROCEDURE 3
Operation 3A
52
52
50
50

Fig. 58

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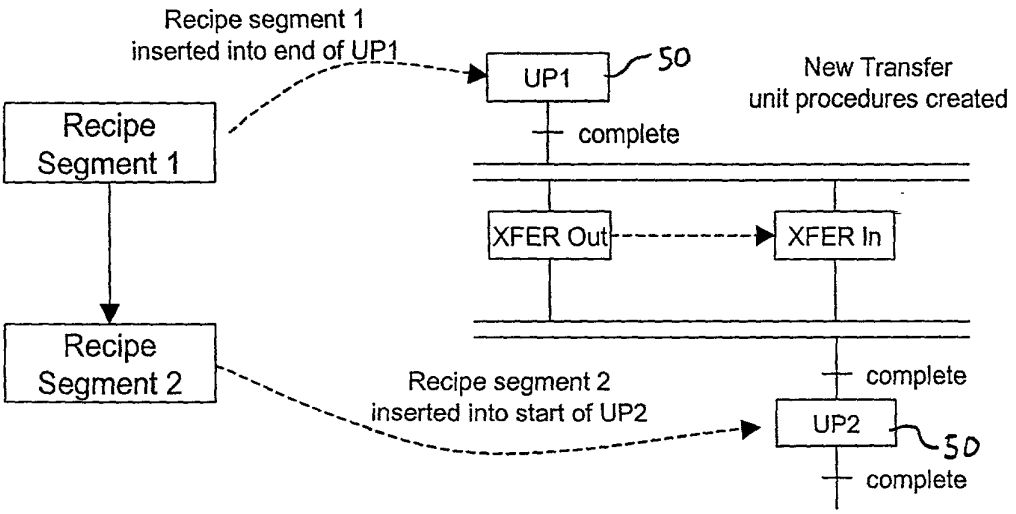

Fig. 59

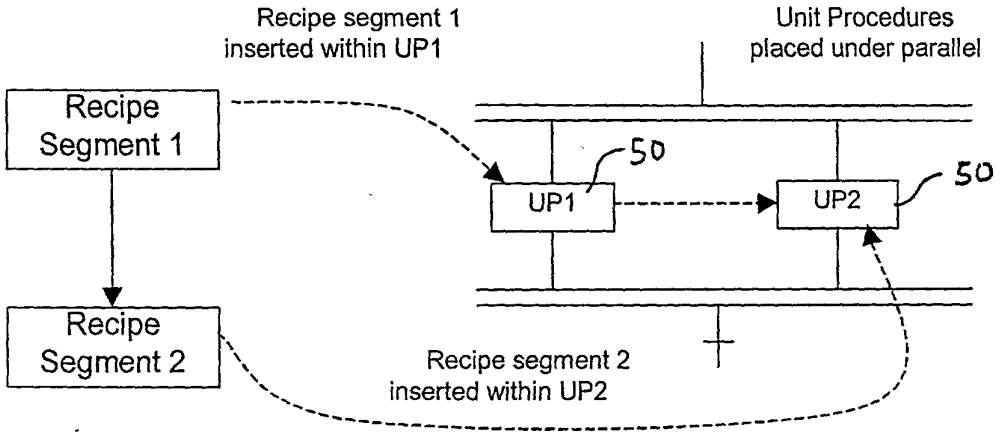

Fig. 60

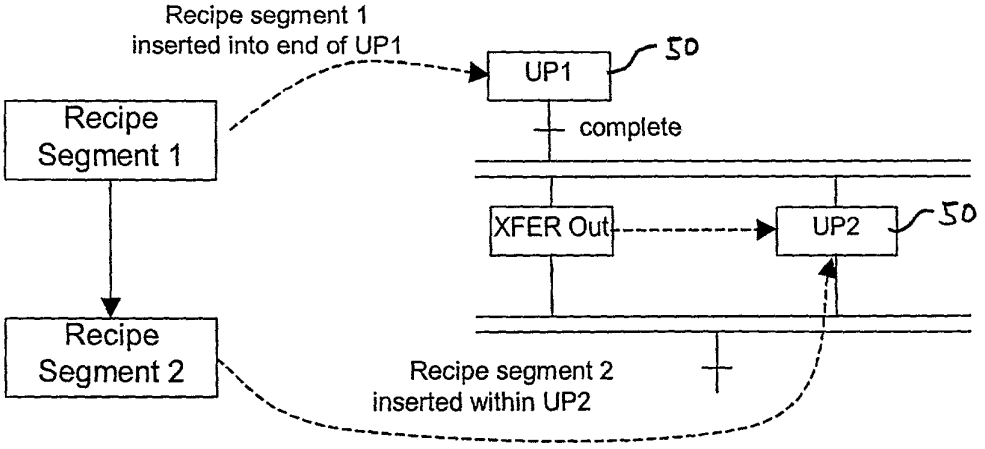

Fig. 61

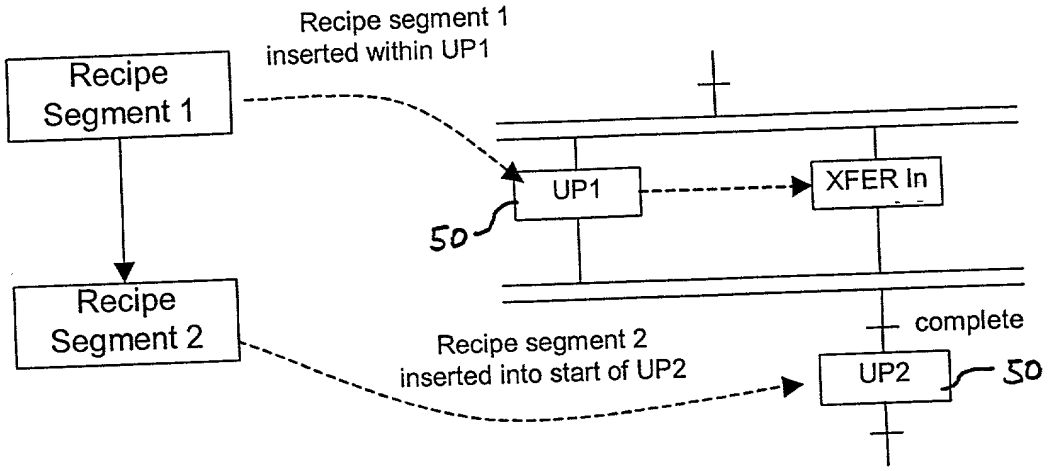
Recipe segment 1
inserted within UP1
Recipe
Segment 1
UP1
XFER In
50
Recipe
Segment 2
complete
Recipe segment 2
inserted into start of UP2
UP2
50

Fig. 62

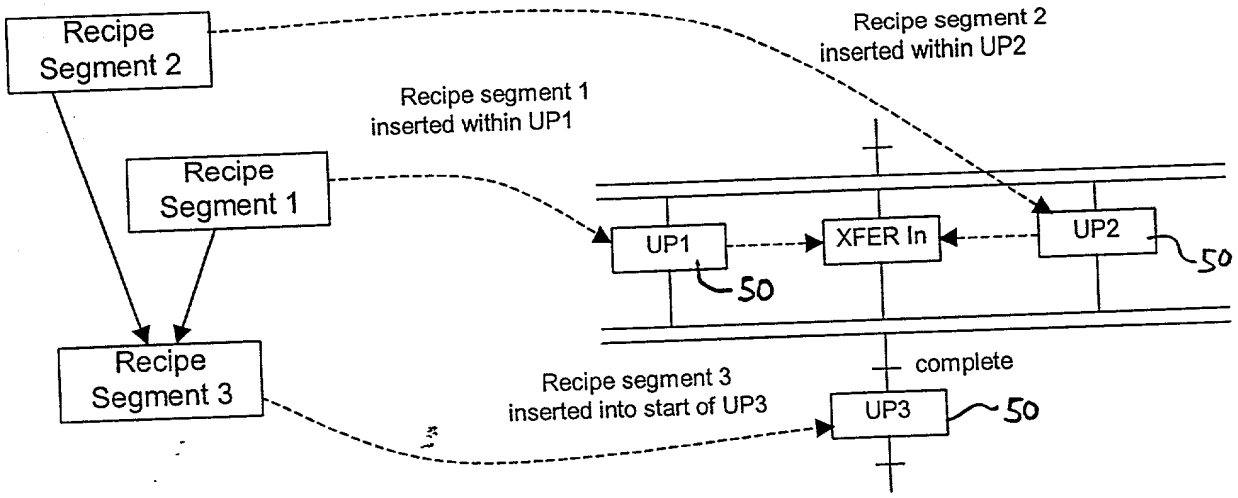
Recipe
Segment 2
Recipe segment 2
inserted within UP2
Recipe segment 1
inserted within UP1
Recipe
Segment 1
UP1
XFER In
UP2
50
50
Recipe
Segment 3
complete
Recipe segment 3
inserted into start of UP3
UP3
50

Fig. 63

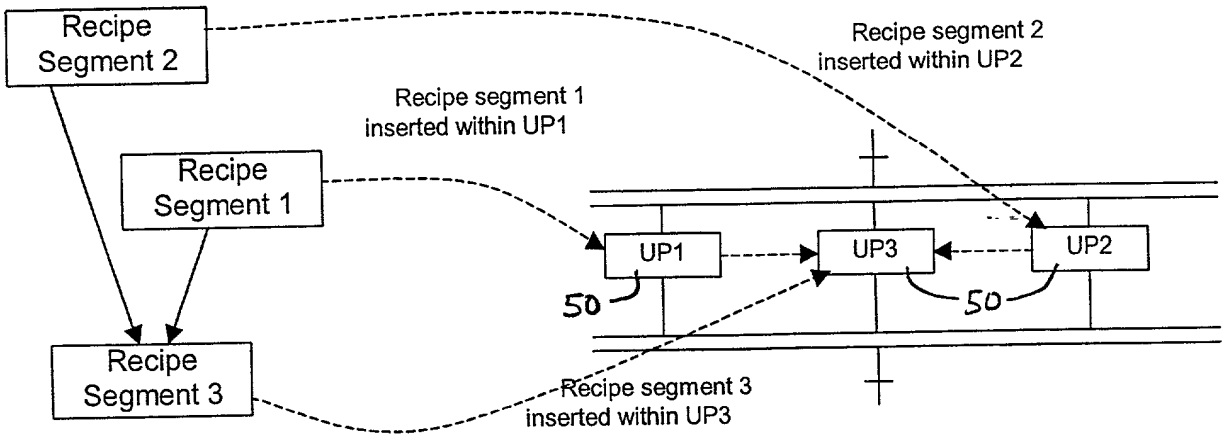

Fig. 64

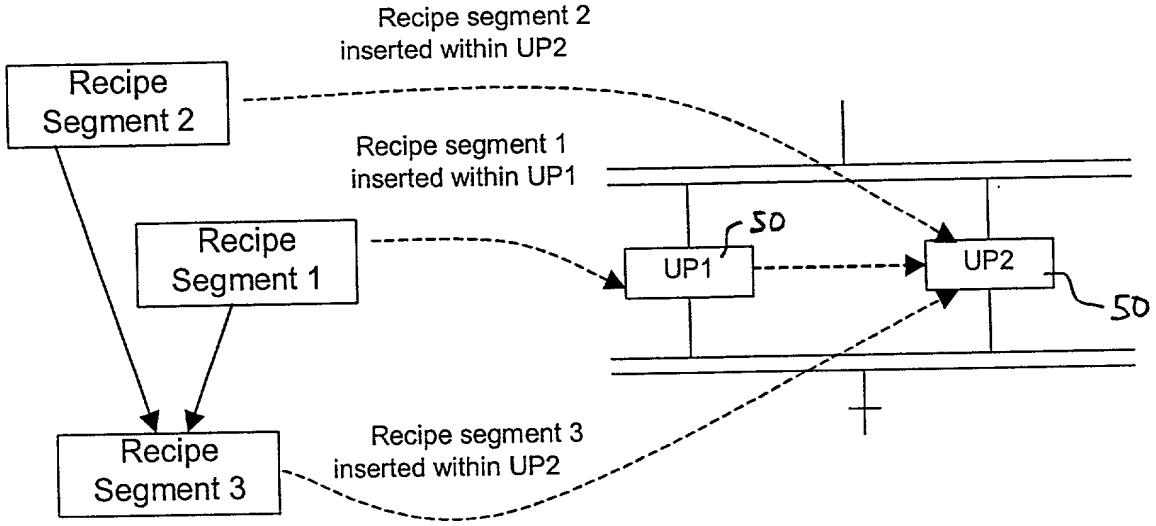

Fig. 65

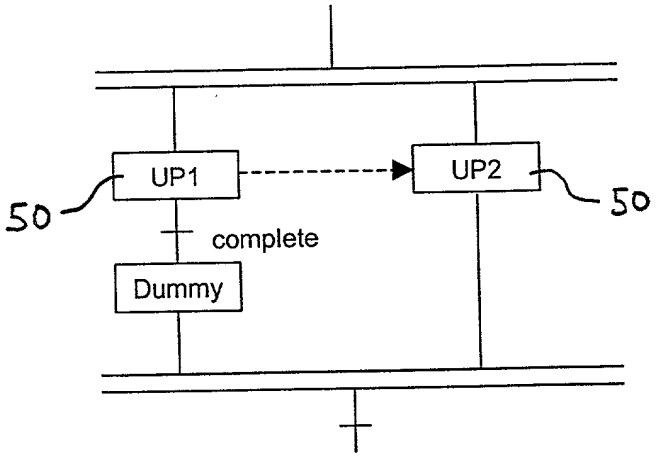

Fig. 66

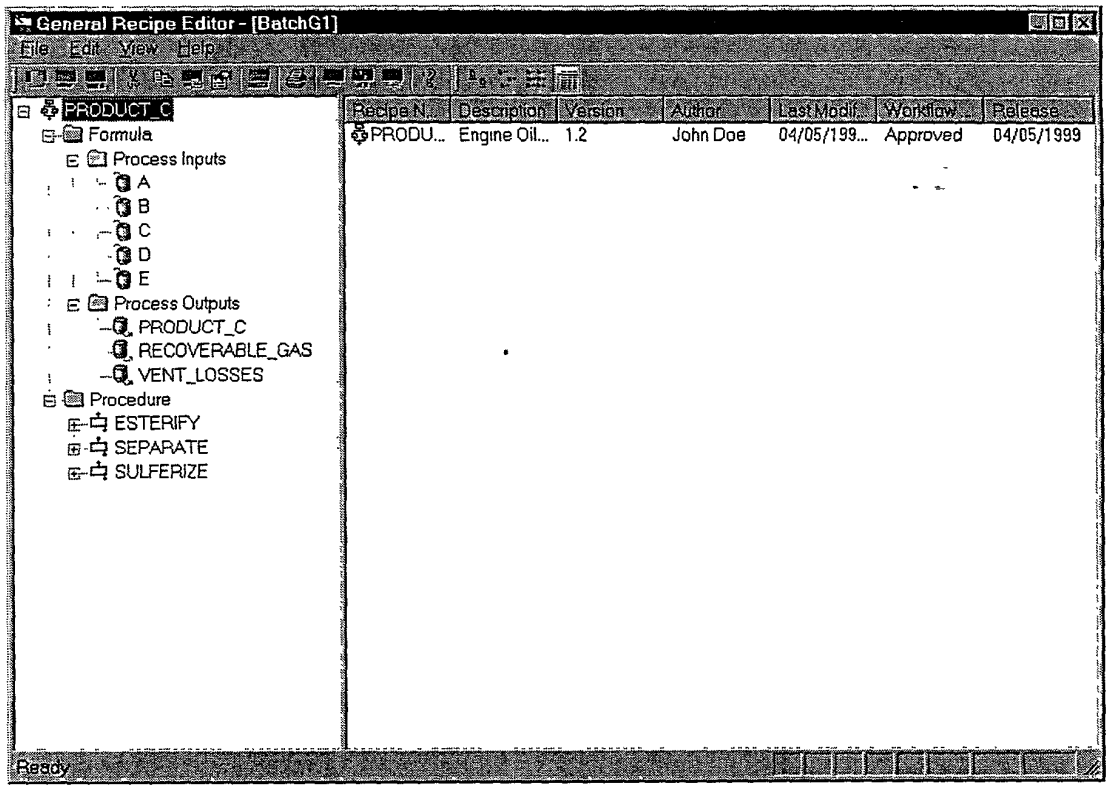
General Recipe Editor - [BatchG1]
File Edit View Help
PRODUCT_C
Formula
Process Inputs
A
B
C
D
E
Process Outputs
PRODUCT_C
RECOVERABLE_GAS
VENT_LOSSES
Procedure
ESTERIFY
SEPARATE
SULFERIZE
Recipe N... Description Version Author Last Modif... Workflow ... Release ...
PRODU... Engine Oil... 1.2 John Doe 04/05/199... Approved 04/05/1999
Ready

Fig. 67

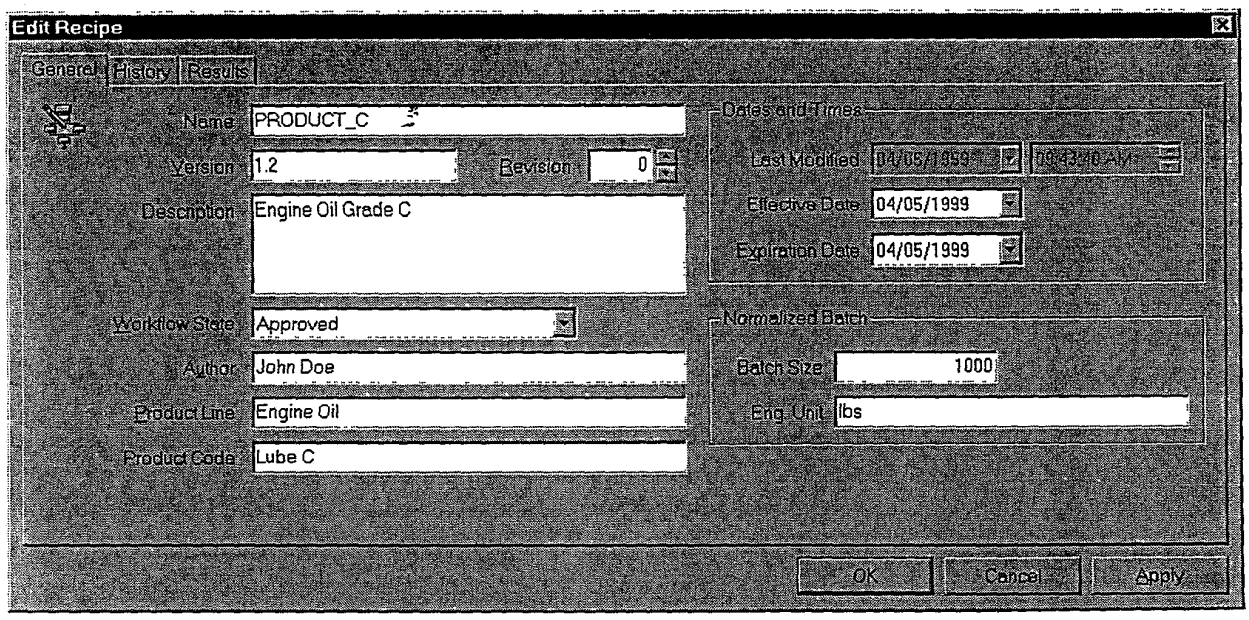
Edit Recipe
General History Results
Name PRODUCT_C
Version 1.2
Revision 0
Description Engine Oil Grade C
Workflow State Approved
Author John Doe
Product Line Engine Oil
Product Code Lube C
Dates and Times
Last Modified 04/05/1999 09:43:16 AM
Effective Date 04/05/1999
Expiration Date 04/05/1999
Normalized Batch
Batch Size 1000
Eng. Unit lbs
OK
Cancel
Apply

Fig. 68

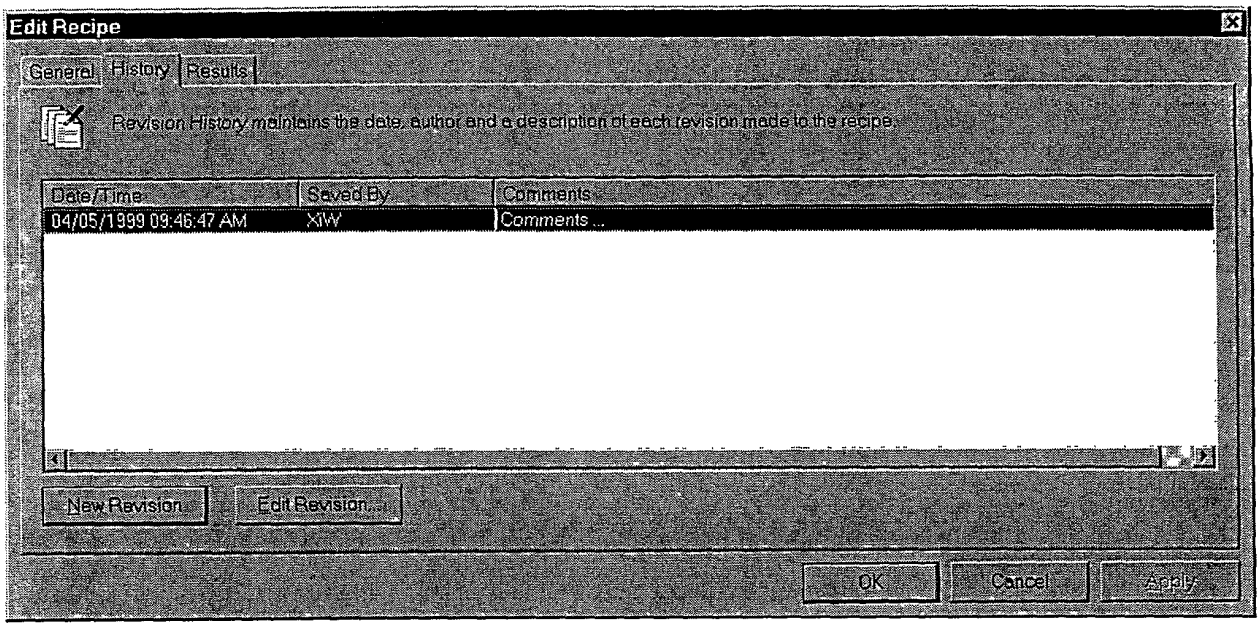

Fig. 69

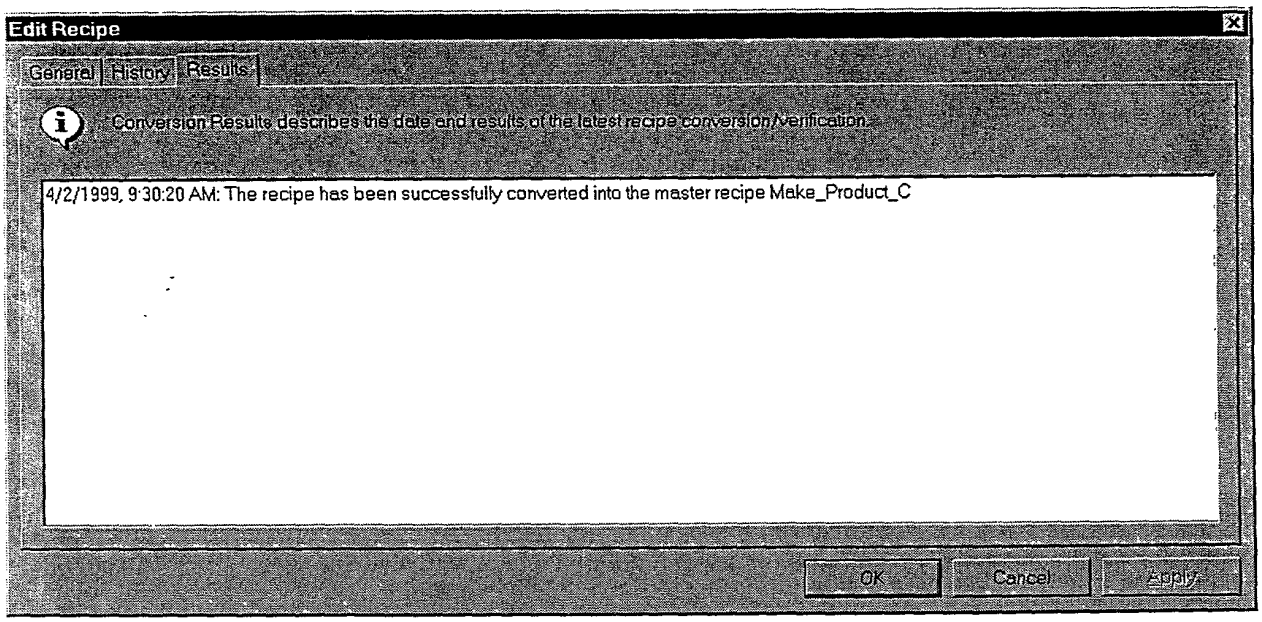

Fig. 70

Applied Biosystems - Exhibit 2016

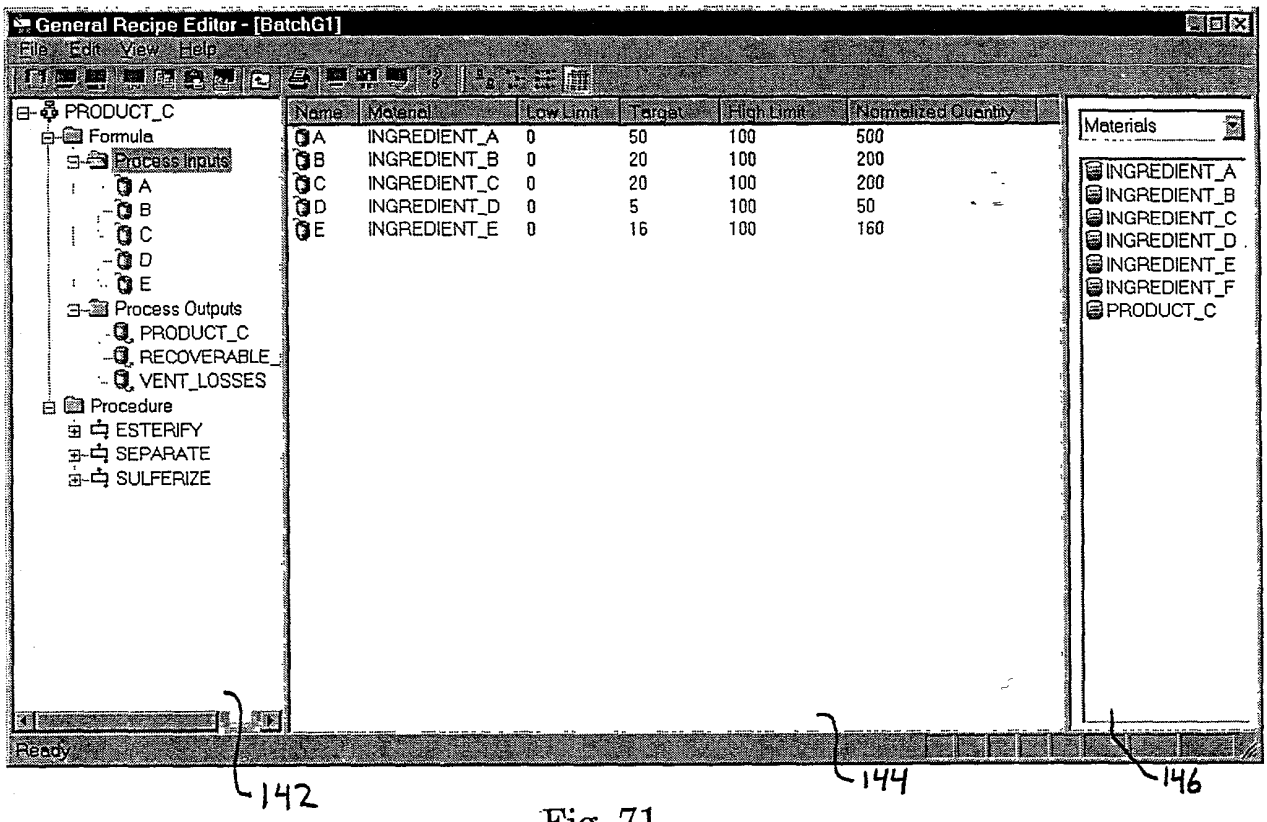
General Recipe Editor - [BatchG1]
File Edit View Help
PRODUCT_C
Formula
Process Inputs
A
B
C
D
E
Process Outputs
PRODUCT_C
RECOVERABLE_
VENT_LOSSES
Procedure
ESTERIFY
SEPARATE
SULFERIZE
Name
Material
Low Limit
Target
High Limit
Normalized Quantity
A INGREDIENT_A 0 50 100 500
B INGREDIENT_B 0 20 100 200
C INGREDIENT_C 0 20 100 200
D INGREDIENT_D 0 5 100 50
E INGREDIENT_E 0 16 100 160
Materials
INGREDIENT_A
INGREDIENT_B
INGREDIENT_C
INGREDIENT_D
INGREDIENT_E
INGREDIENT_F
PRODUCT_C
Ready
142
144
146

Fig. 71

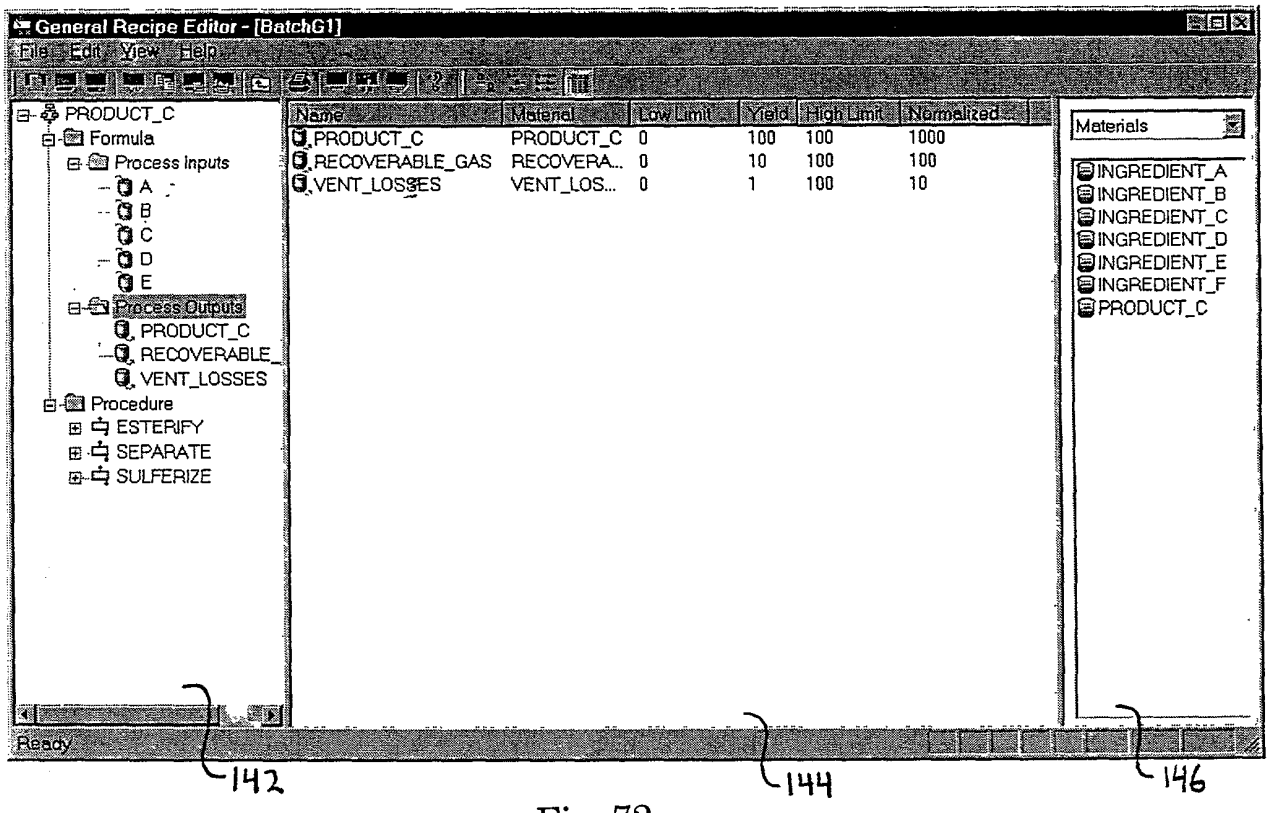
General Recipe Editor - [BatchG1]
File Edit View Help
PRODUCT_C
Formula
Process Inputs
A
B
C
D
E
Process Outputs
PRODUCT_C
RECOVERABLE_
VENT_LOSSES
Procedure
ESTERIFY
SEPARATE
SULFERIZE
Name
Material
Low Limit
Yield
High Limit
Normalized
PRODUCT_C PRODUCT_C 0 100 100 1000
RECOVERABLE_GAS RECOVERA... 0 10 100 100
VENT_LOSSES VENT_LOS... 0 1 100 10
Materials
INGREDIENT_A
INGREDIENT_B
INGREDIENT_C
INGREDIENT_D
INGREDIENT_E
INGREDIENT_F
PRODUCT_C
Ready
142
144
146

Fig. 72

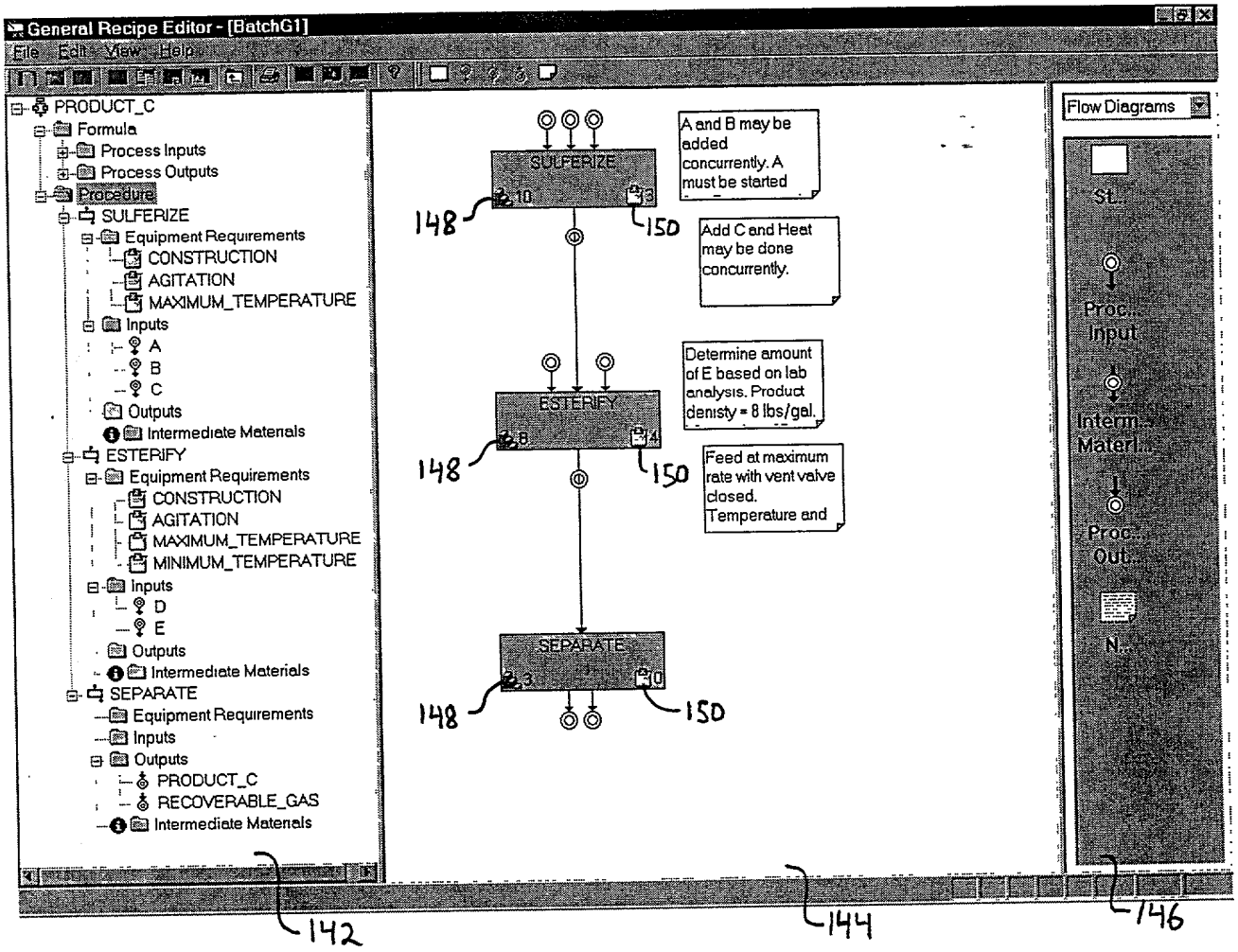
General Recipe Editor - [BatchG1]
File Edit View Help
PRODUCT_C
Formula
Process Inputs
Process Outputs
Procedure
SULFERIZE
Equipment Requirements
CONSTRUCTION
AGITATION
MAXIMUM_TEMPERATURE
Inputs
A
B
C
Outputs
Intermediate Materials
ESTERIFY
Equipment Requirements
CONSTRUCTION
AGITATION
MAXIMUM_TEMPERATURE
MINIMUM_TEMPERATURE
Inputs
D
E
Outputs
Intermediate Materials
SEPARATE
Equipment Requirements
Inputs
Outputs
PRODUCT_C
RECOVERABLE_GAS
Intermediate Materials
SULFERIZE
ESTERIFY
SEPARATE
A and B may be added concurrently. A must be started
Add C and Heat may be done concurrently.
Determine amount of E based on lab analysis. Product density = 8 lbs/gal.
Feed at maximum rate with vent valve closed. Temperature and
148
150
Flow Diagrams
Proc... Input
Interm... Materi...
Proc... Out...
142
144
146

Fig. 73

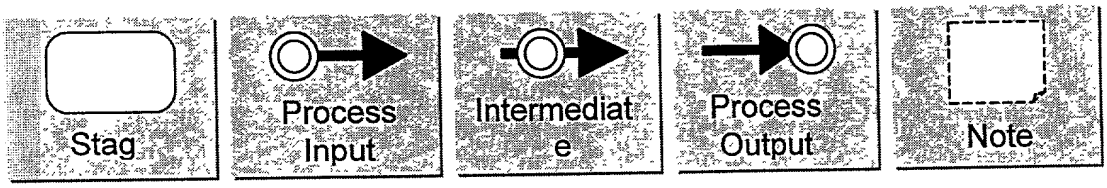
Stag
Process Input
Intermediat e
Process Output
Note

Fig. 74

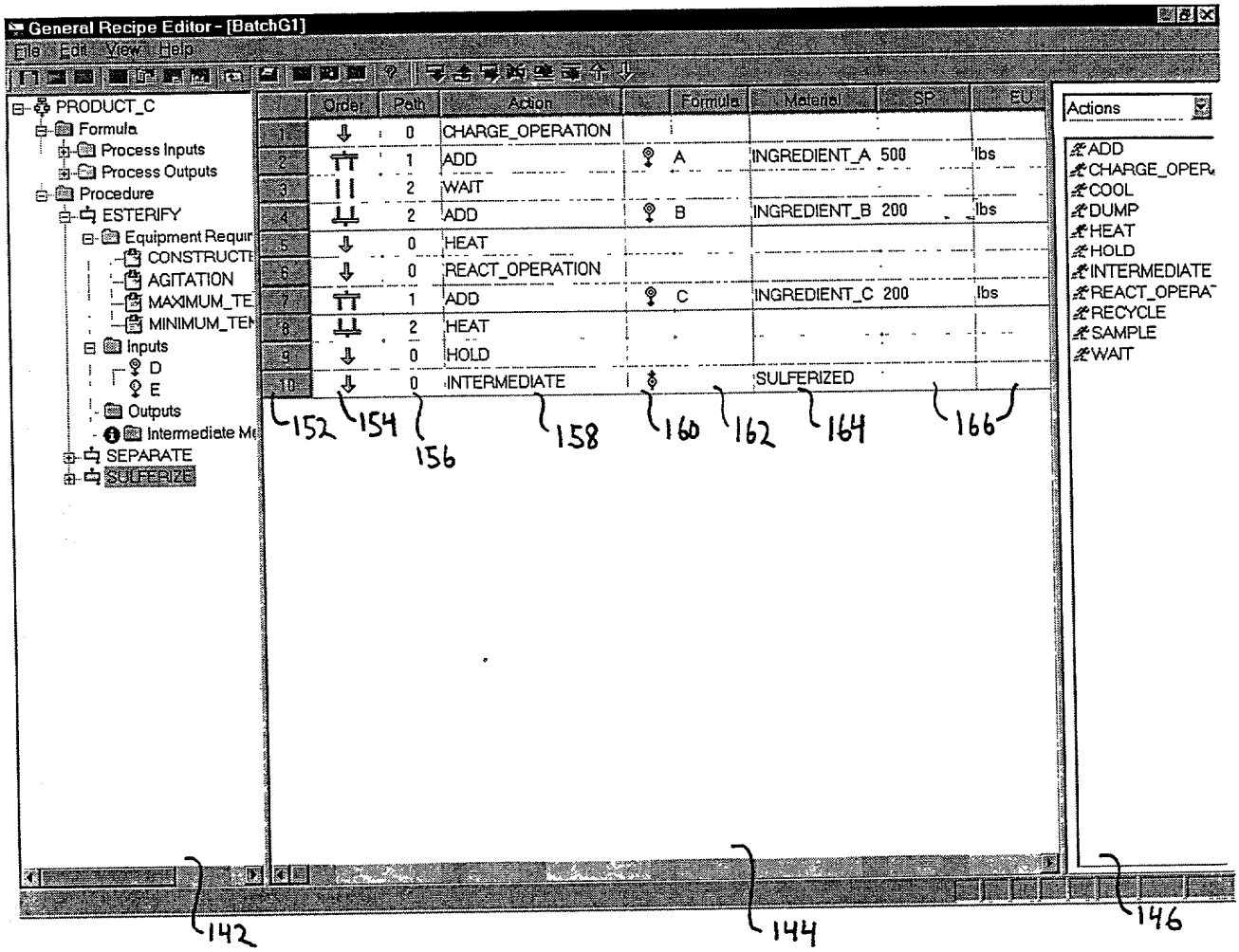
General Recipe Editor - [BatchG1]
File Edit View Help
PRODUCT_C
Formula
Process Inputs
Process Outputs
Procedure
ESTERIFY
Equipment Requir
CONSTRUCTI
AGITATION
MAXIMUM_TE
MINIMUM_TEI
Inputs
D
E
Outputs
Intermediate Mt
SEPARATE
SULFERIZE
Order
Path
Action
Formula
Material
SP
EU
1 0 CHARGE_OPERATION
2 1 ADD A INGREDIENT_A 500 lbs
3 2 WAIT
4 2 ADD B INGREDIENT_B 200 lbs
5 0 HEAT
6 0 REACT_OPERATION
7 1 ADD C INGREDIENT_C 200 lbs
8 2 HEAT
9 0 HOLD
10 0 INTERMEDIATE SULFERIZED
Actions
ADD
CHARGE_OPER
COOL
DUMP
HEAT
HOLD
INTERMEDIATE
REACT_OPERA
RECYCLE
SAMPLE
WAIT
152
154
156
158
160
162
164
166
142
144
146

Fig. 75

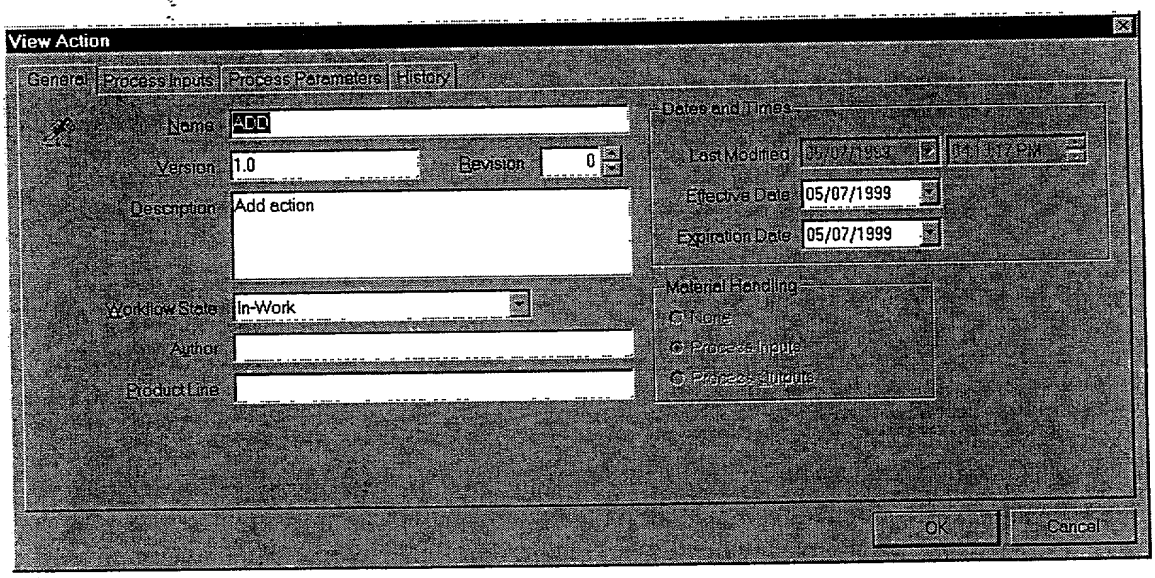
View Action
General
Process Inputs
Process Parameters
History
Name ADD
Version 1.0
Revision 0
Description Add action
Workflow State In-Work
Author
Product Line
Dates and Times
Last Modified 05/07/1999 11:17 PM
Effective Date 05/07/1999
Expiration Date 05/07/1999
Material Handling
None
Process Inputs
Process Outputs
OK
Cancel

Fig. 76

Patent Application Publication Aug. 26, 2004 Sheet 69 of 74 US 2004/0167804 A1

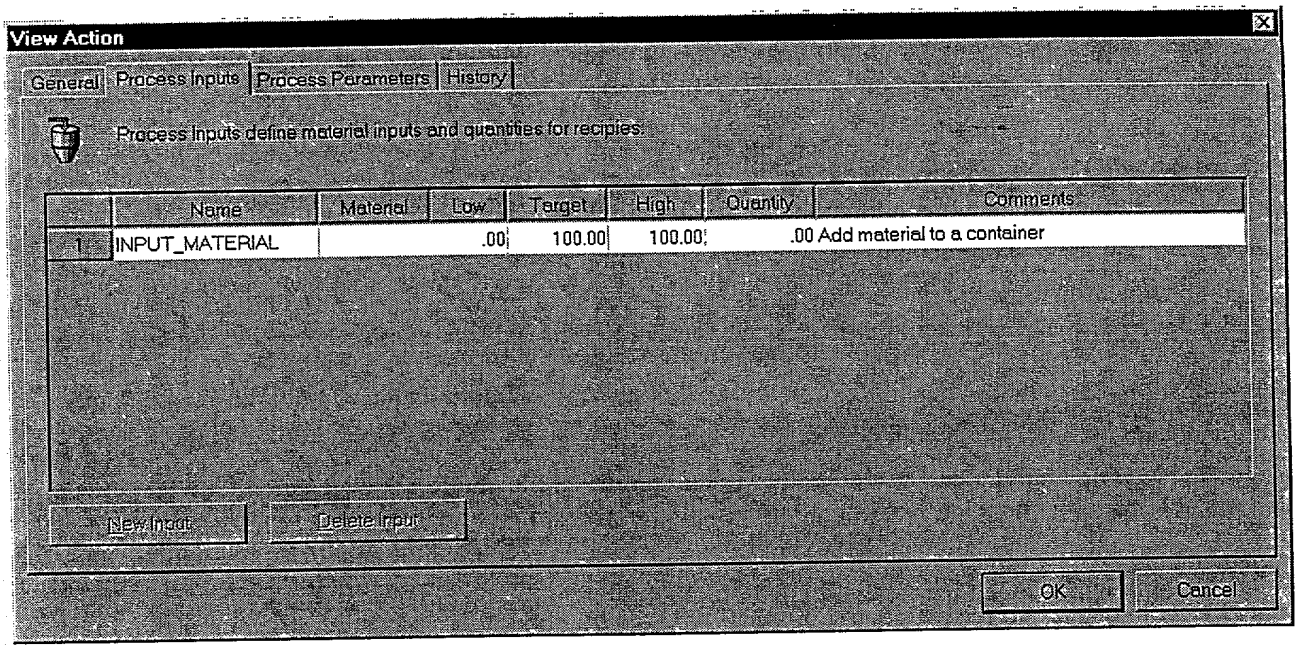

Fig. 77

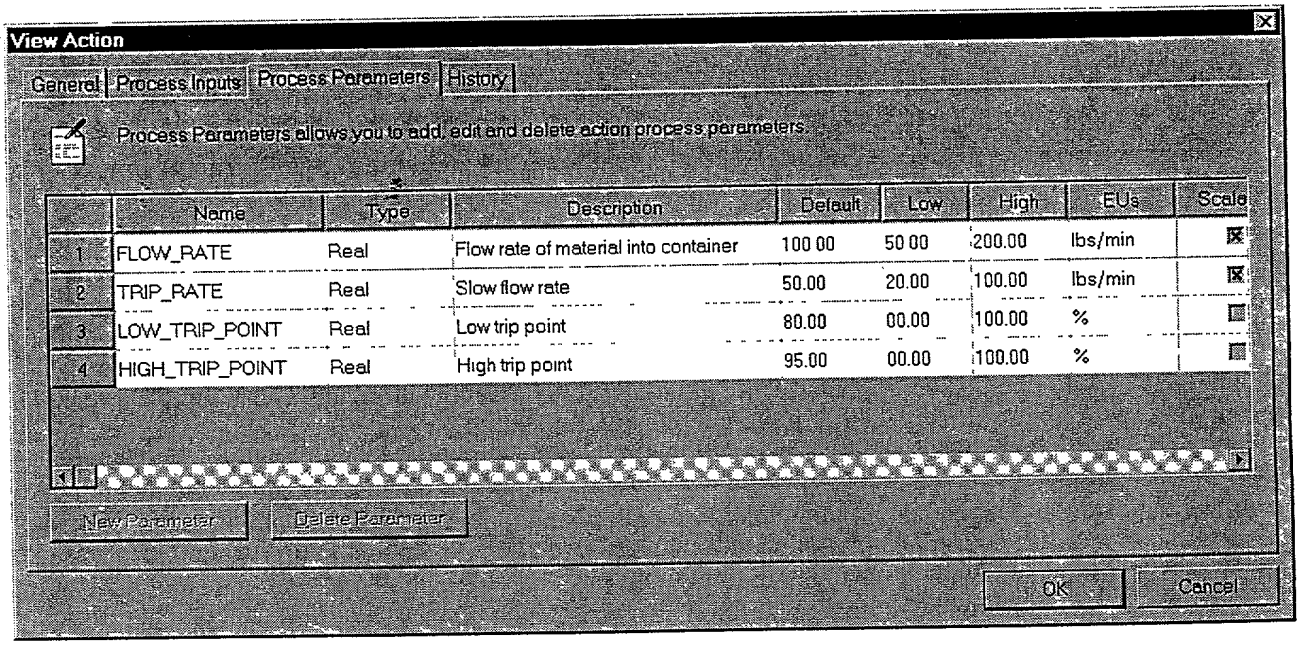

Fig. 78

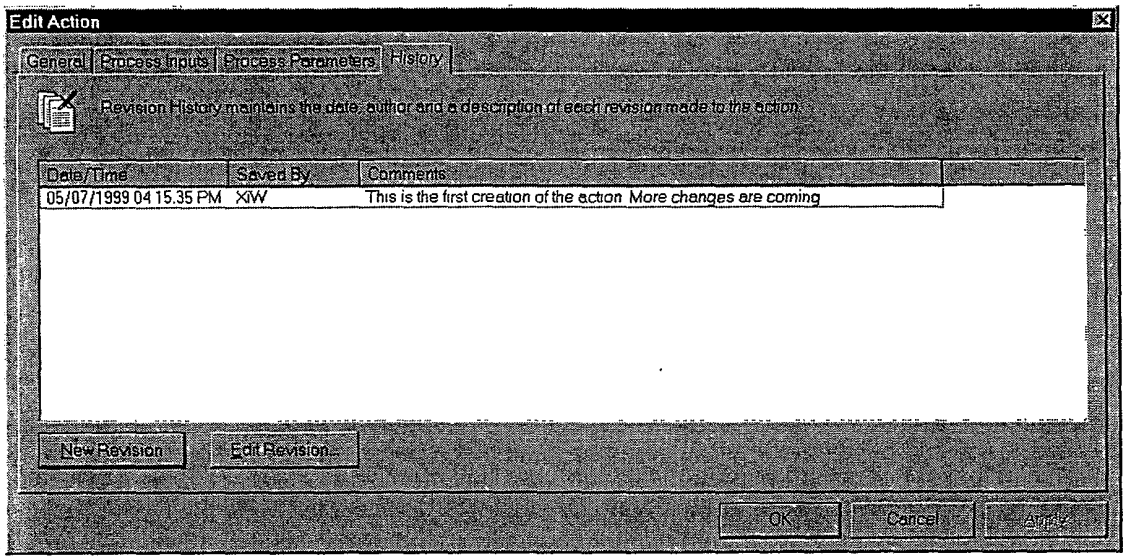
Edit Action
General
Process Inputs
Process Parameters
History
Revision History maintains the date, author and a description of each revision made to the action.
Date/Time
Saved By
Comments
05/07/1999 04:15:35 PM
XIW
This is the first creation of the action. More changes are coming
New Revision...
Edit Revision...
OK
Cancel
Apply

Fig. 79

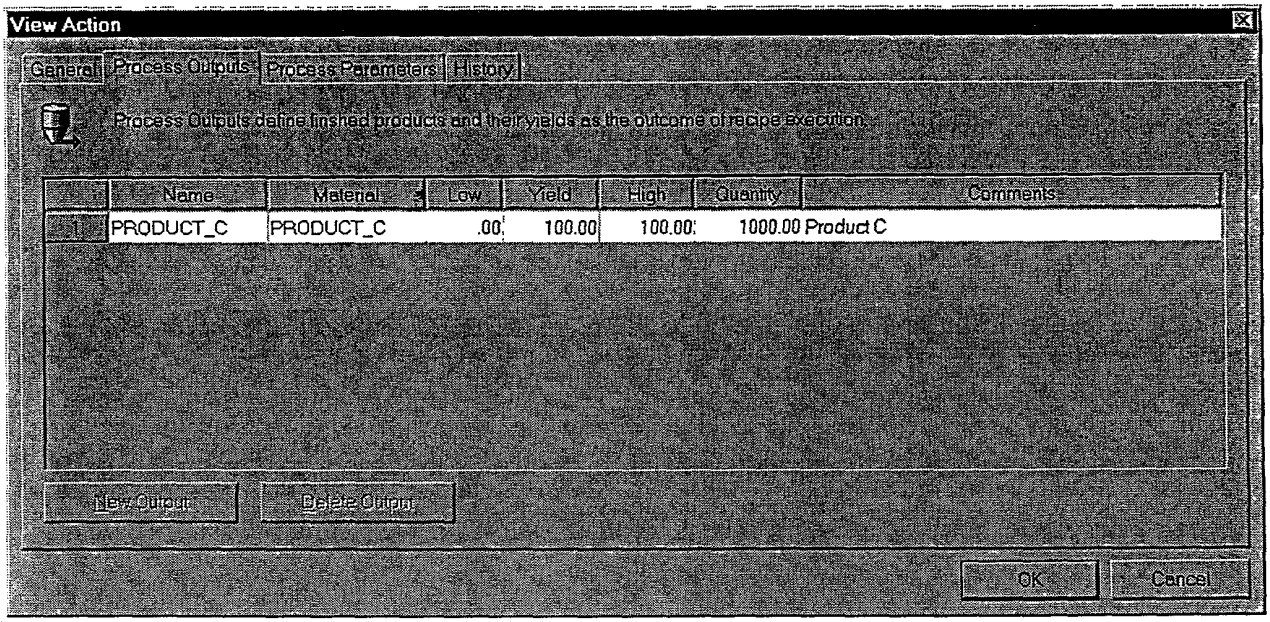
View Action
General
Process Outputs
Process Parameters
History
Process Outputs define finished products and their yields as the outcome of recipe execution.
Name
Material
Low
Yield
High
Quantity
Comments
1
PRODUCT_C
PRODUCT_C
.00
100.00
100.00
1000.00
Product C
New Output...
Delete Output
OK
Cancel

Fig. 80

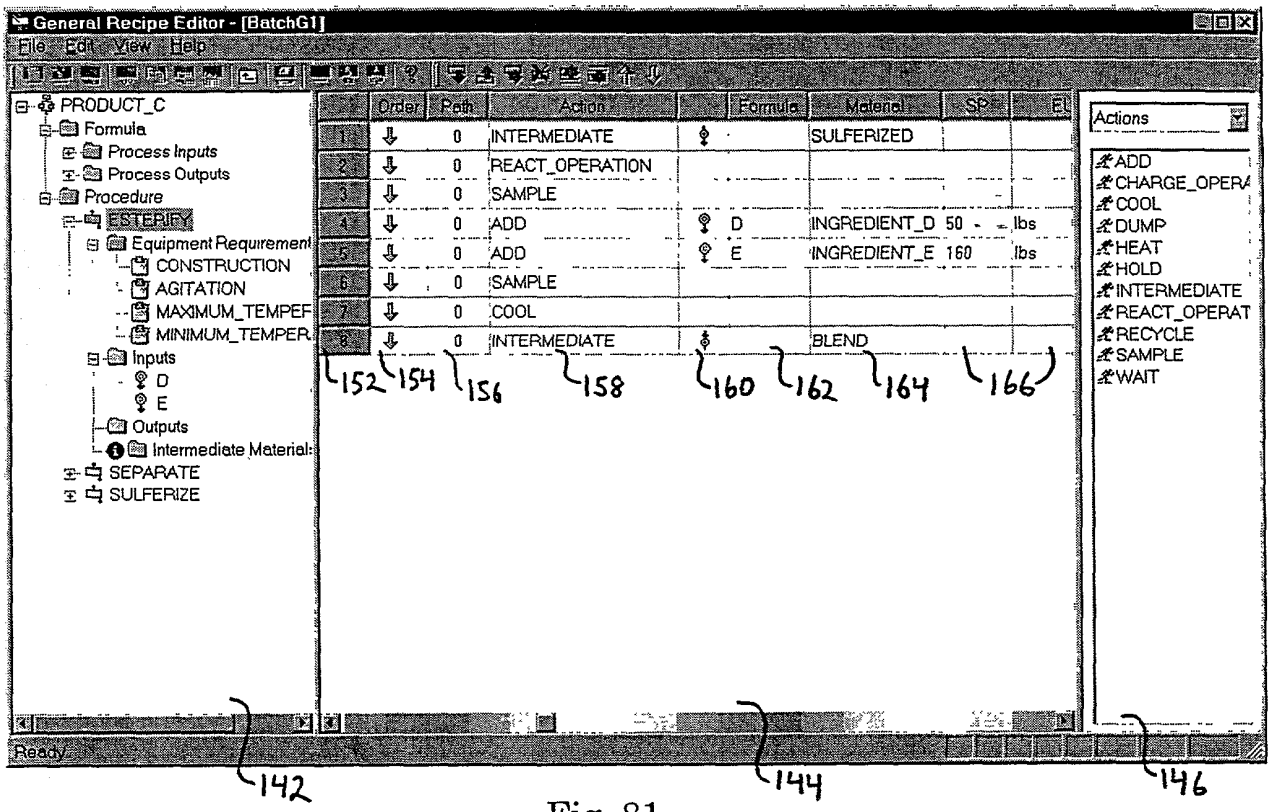
General Recipe Editor - [BatchG1]
File Edit View Help
PRODUCT_C
Formula
Process Inputs
Process Outputs
Procedure
ESTERIFY
Equipment Requirement
CONSTRUCTION
AGITATION
MAXIMUM_TEMPEF
MINIMUM_TEMPER
Inputs
D
E
Outputs
Intermediate Material
SEPARATE
SULFERIZE
Order
Path
Action
Formula
Material
SP
EL
1 0 INTERMEDIATE SULFERIZED
2 0 REACT_OPERATION
3 0 SAMPLE
4 0 ADD D INGREDIENT_D 50 lbs
5 0 ADD E INGREDIENT_E 160 lbs
6 0 SAMPLE
7 0 COOL
8 0 INTERMEDIATE BLEND
Actions
ADD
CHARGE_OPERA
COOL
DUMP
HEAT
HOLD
INTERMEDIATE
REACT_OPERAT
RECYCLE
SAMPLE
WAIT
Ready
142
144
146
152
154
156
158
160
162
164
166

Fig. 81

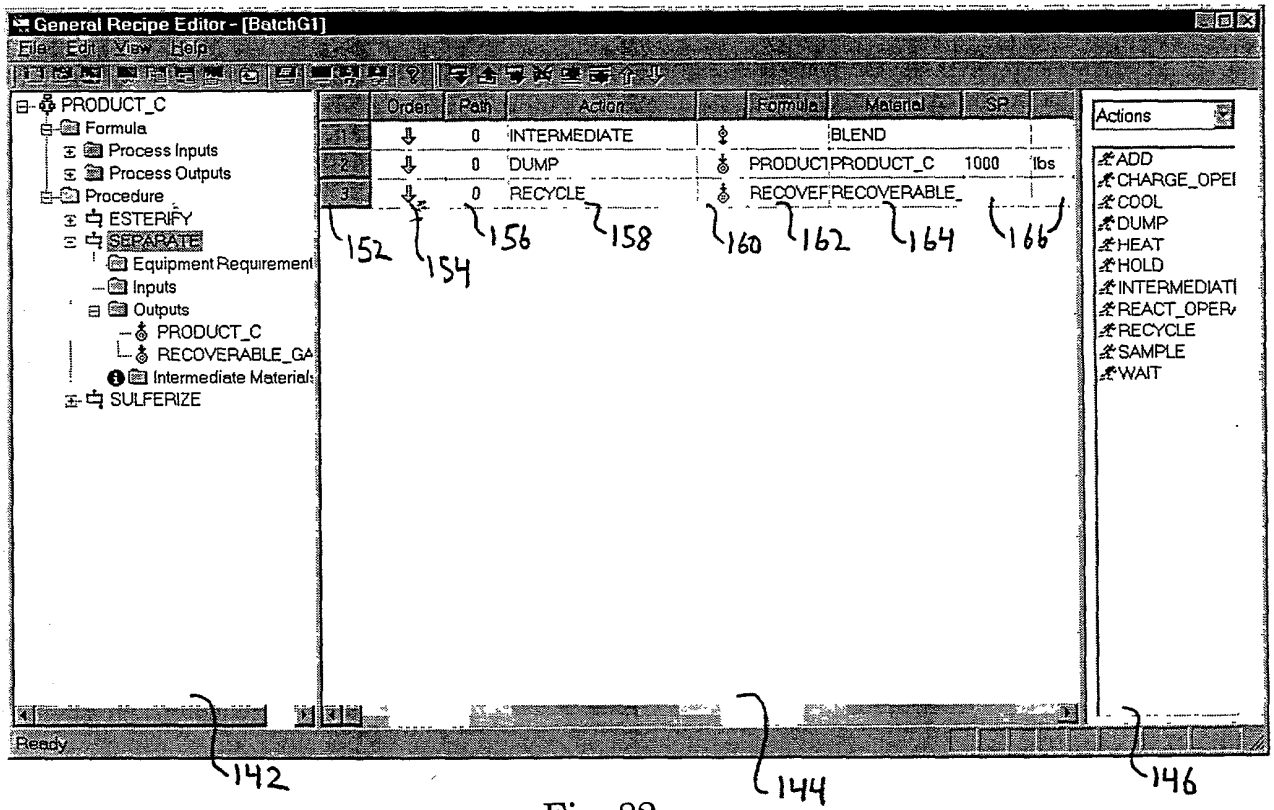
General Recipe Editor - [BatchG1]
File Edit View Help
PRODUCT_C
Formula
Process Inputs
Process Outputs
Procedure
ESTERIFY
SEPARATE
Equipment Requirement
Inputs
Outputs
PRODUCT_C
RECOVERABLE_GA
Intermediate Materials
SULFERIZE
Order
Path
Action
Formula
Material
SP
1 0 INTERMEDIATE BLEND
2 0 DUMP PRODUCT PRODUCT_C 1000 lbs
3 0 RECYCLE RECOVEF RECOVERABLE_
Actions
ADD
CHARGE_OPEI
COOL
DUMP
HEAT
HOLD
INTERMEDIATI
REACT_OPER/
RECYCLE
SAMPLE
WAIT
Ready
142
144
146
152
154
156
158
160
162
164
166

Fig. 82

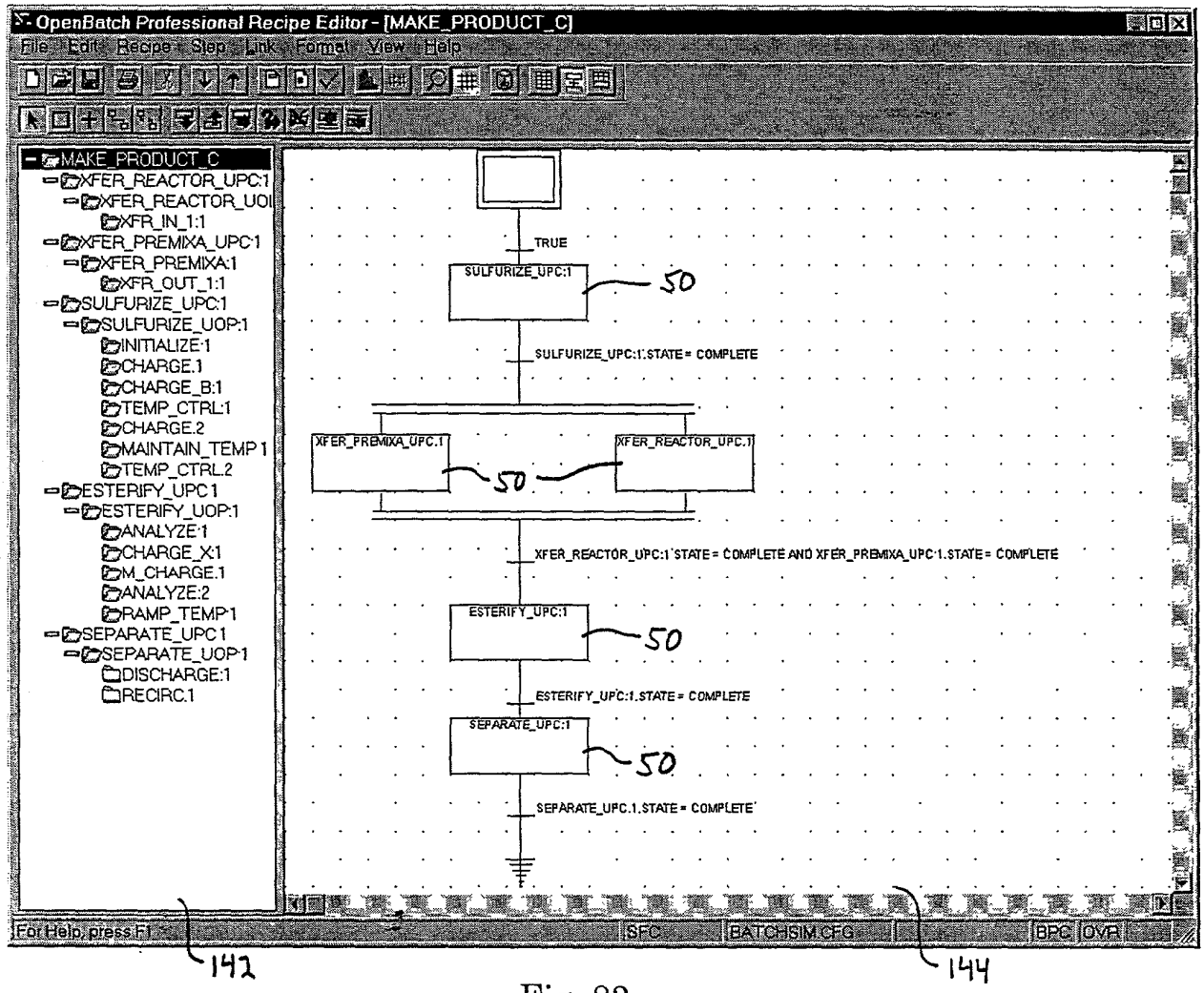
OpenBatch Professional Recipe Editor - [MAKE_PRODUCT_C]
File Edit Recipe Step Link Format View Help
MAKE_PRODUCT_C
XFER_REACTOR_UPC:1
XFER_REACTOR_UOI
XFR_IN_1:1
XFER_PREMIXA_UPC:1
XFER_PREMIXA:1
XFR_OUT_1:1
SULFURIZE_UPC:1
SULFURIZE_UOP:1
INITIALIZE:1
CHARGE:1
CHARGE_B:1
TEMP_CTRL:1
CHARGE:2
MAINTAIN_TEMP:1
TEMP_CTRL:2
ESTERIFY_UPC:1
ESTERIFY_UOP:1
ANALYZE:1
CHARGE_X:1
M_CHARGE:1
ANALYZE:2
RAMP_TEMP:1
SEPARATE_UPC:1
SEPARATE_UOP:1
DISCHARGE:1
RECIRC:1
TRUE
SULFURIZE_UPC:1
50
SULFURIZE_UPC:1.STATE = COMPLETE
XFER_PREMIXA_UPC:1
XFER_REACTOR_UPC:1
50
XFER_REACTOR_UPC:1.STATE = COMPLETE AND XFER_PREMIXA_UPC:1.STATE = COMPLETE
ESTERIFY_UPC:1
50
ESTERIFY_UPC:1.STATE = COMPLETE
SEPARATE_UPC:1
50
SEPARATE_UPC.1.STATE = COMPLETE
For Help, press F1
SFC
BATCHSIM.CFG
BPC
OVR
142
144

Fig. 83

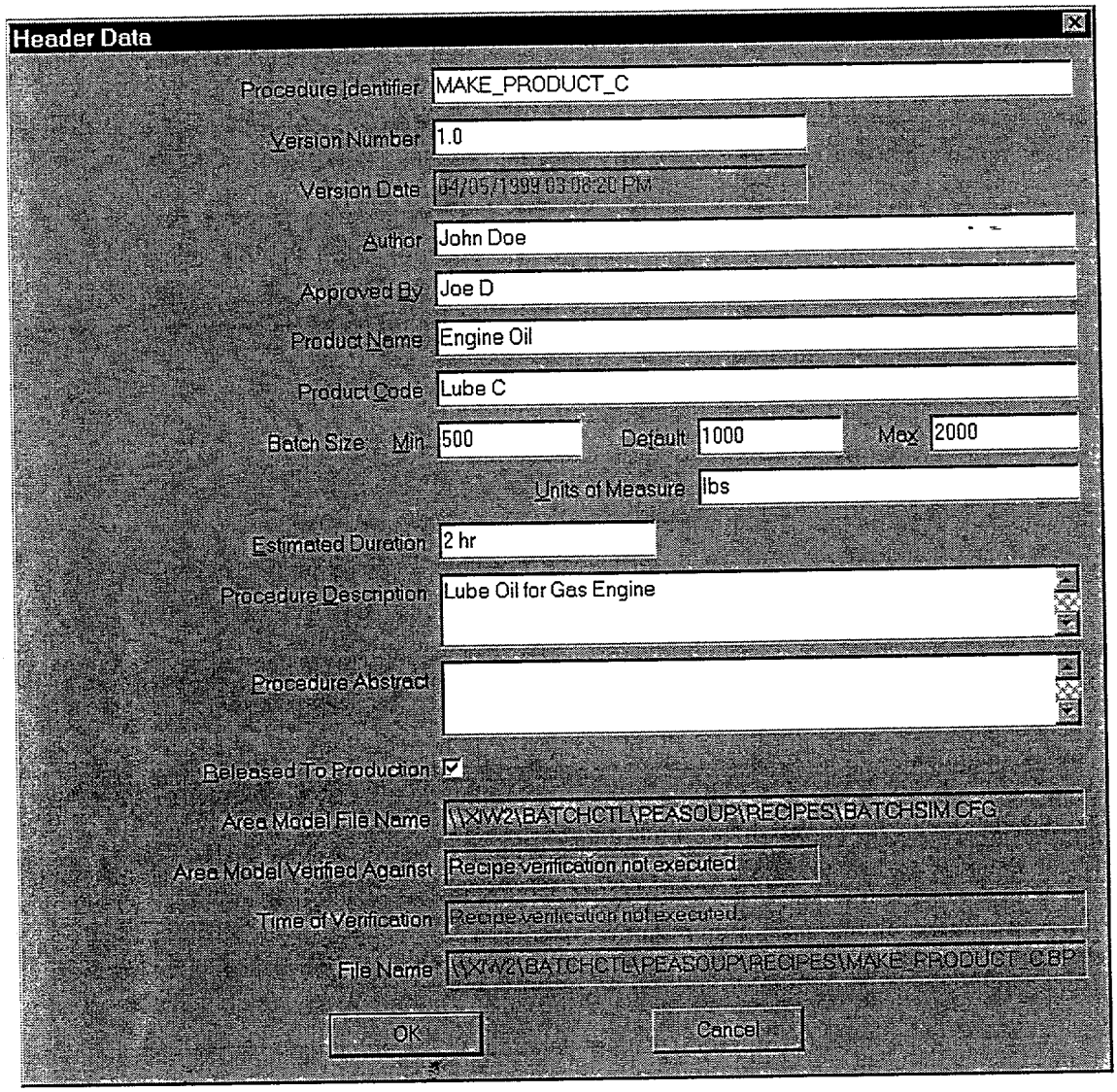
Header Data
Procedure Identifier
MAKE_PRODUCT_C
Version Number
1.0
Version Date
04/05/1999 03:08:20 PM
Author
John Doe
Approved By
Joe D
Product Name
Engine Oil
Product Code
Lube C
Batch Size - Min
500
Default
1000
Max
2000
Units of Measure
lbs
Estimated Duration
2 hr
Procedure Description
Lube Oil for Gas Engine
Procedure Abstract
Released To Production
Area Model File Name
\\XW2\BATCHCTL\PEASOUP\RECIPES\BATCHSIM.CFG
Area Model Verified Against
Recipe verification not executed.
Time of Verification
Recipe verification not executed.
File Name
\\XW2\BATCHCTL\PEASOUP\RECIPES\MAKE_PRODUCT_C.BP
OK
Cancel

Fig. 84

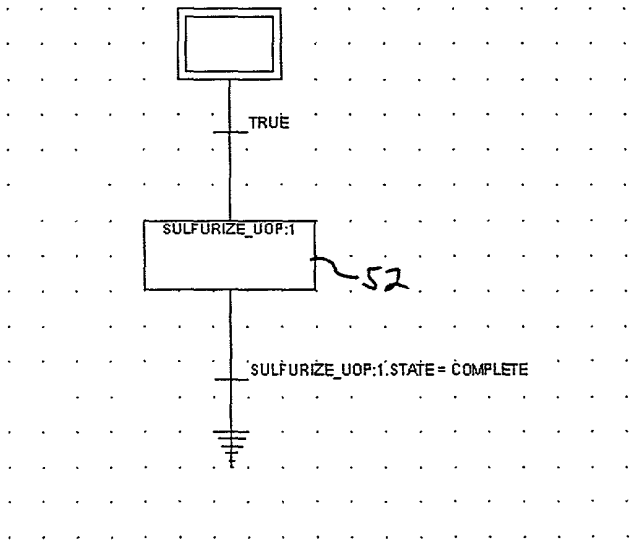

Fig. 85

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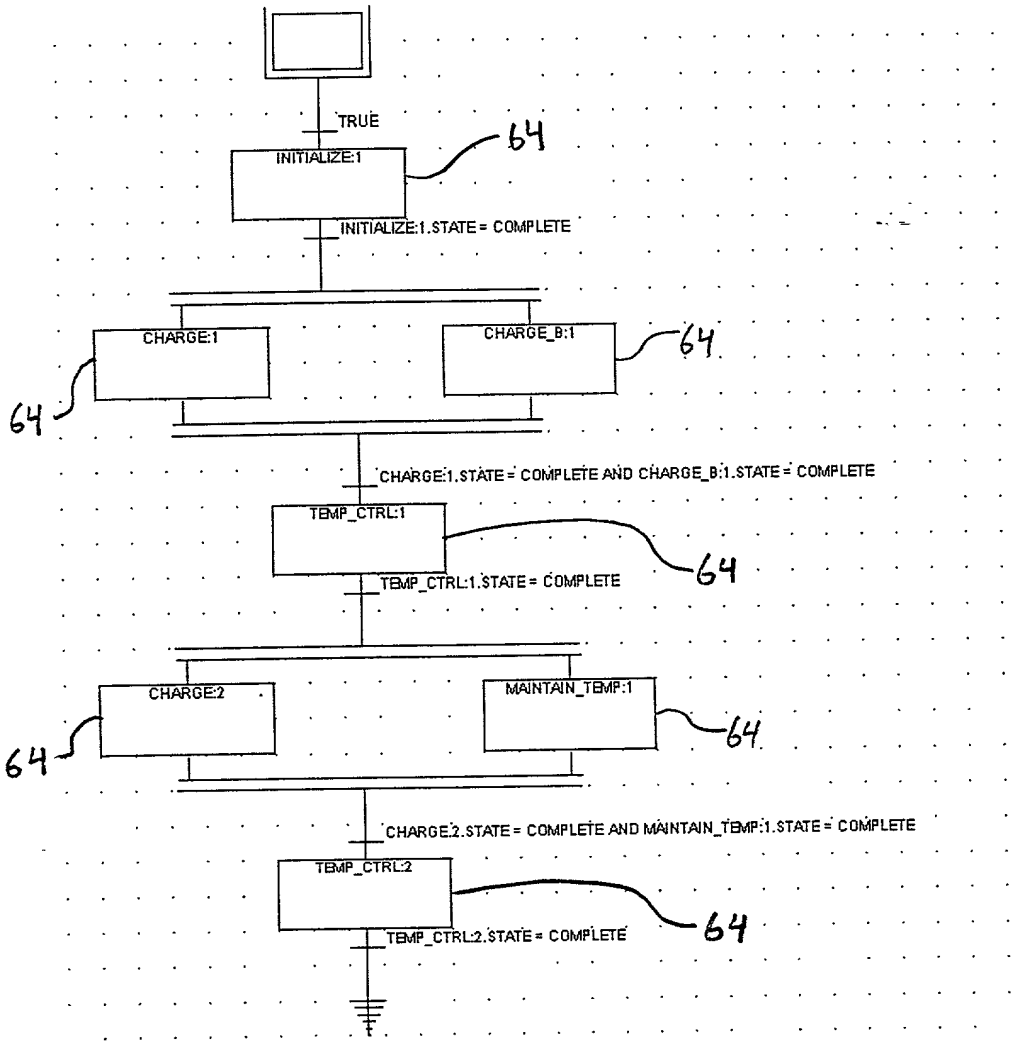
TRUE
INITIALIZE:1
64
INITIALIZE:1.STATE = COMPLETE
CHARGE:1
CHARGE_B:1
64
64
CHARGE:1.STATE = COMPLETE AND CHARGE_B:1.STATE = COMPLETE
TEMP_CTRL:1
64
TEMP_CTRL:1.STATE = COMPLETE
CHARGE:2
MAINTAIN_TEMP:1
64
64
CHARGE:2.STATE = COMPLETE AND MAINTAIN_TEMP:1.STATE = COMPLETE
TEMP_CTRL:2
64
TEMP_CTRL:2.STATE = COMPLETE

Fig. 86

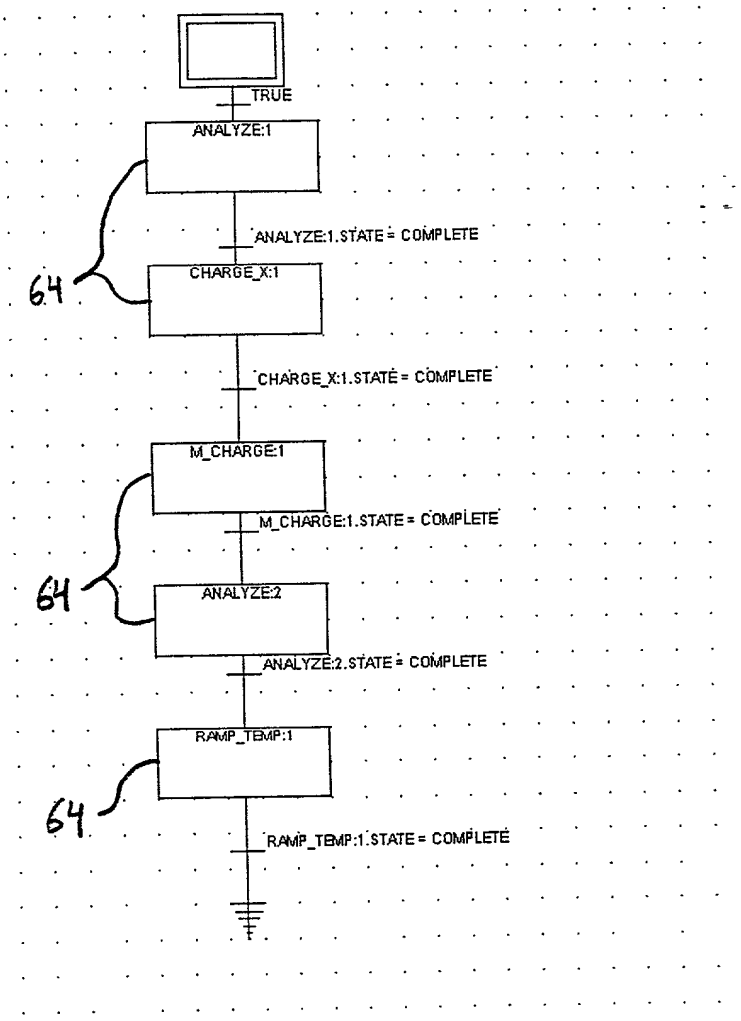
TRUE
ANALYZE:1
ANALYZE:1.STATE = COMPLETE
CHARGE_X:1
64
CHARGE_X:1.STATE = COMPLETE
M_CHARGE:1
M_CHARGE:1.STATE = COMPLETE
ANALYZE:2
64
ANALYZE:2.STATE = COMPLETE
RAMP_TEMP:1
64
RAMP_TEMP:1.STATE = COMPLETE

Fig. 87

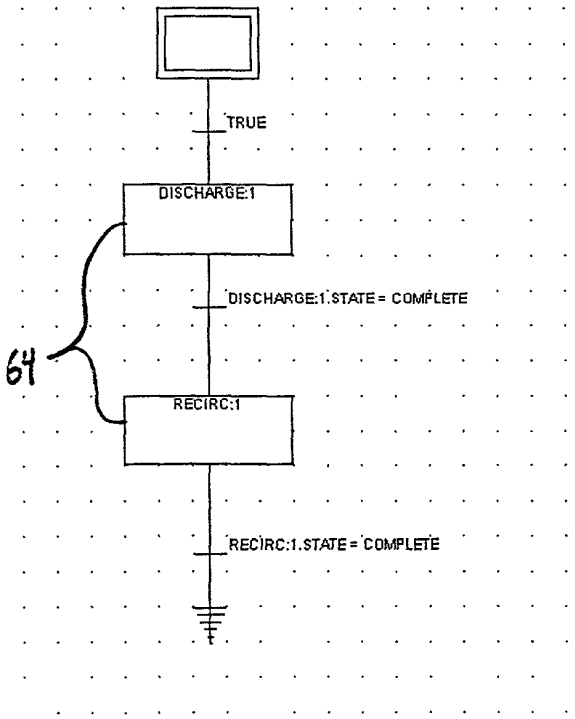

Fig. 88

Recipe Segment	Process Action	Class/Instance Based	Associated Unit	Material
Add, SU2	Charge:1	Instance	Premix_A	A
Add, SU4	Charge_B:1	Instance	Premix_A	B
Add, SU7	Charge:2	Instance	Premix_A	C
Heat, SU5	Temp_Ctrl:1	Class	Premix_A	
Heat, SU8	Maintain_Temp:1	Class	Premix_A	
Hold, SU9	Temp_Ctrl:2	Class	Premix_A	
Add, E4	Charge_X:1	Instance	Reactor_1	D
Add, E5	M_Charge:1	Instance	Reactor_1	E
Sample, E3	Analyze:1	Instance	Reactor_1	
Sample, E6	Analyze:2	Instance	Reactor_1	
Cool, E7	Ramp_Temp:1	Class	Reactor_1	
Dump, SE2	Discharge:1	Instance	Reactor_1	Product_C
Recycle, SE3	Recirc:1	Instance	Reactor_1	Recoverable_Gas

Fig. 89

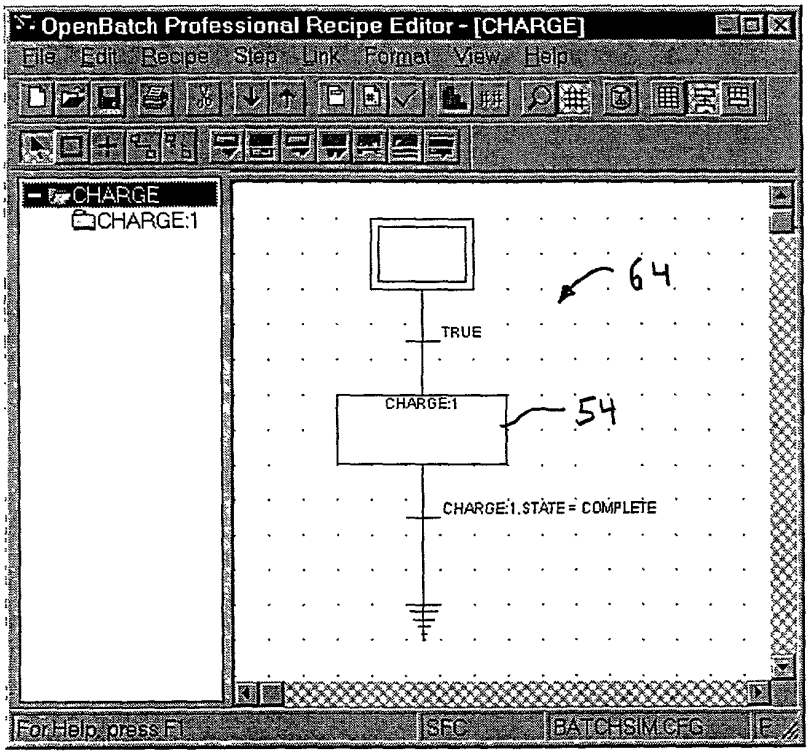

Fig. 90

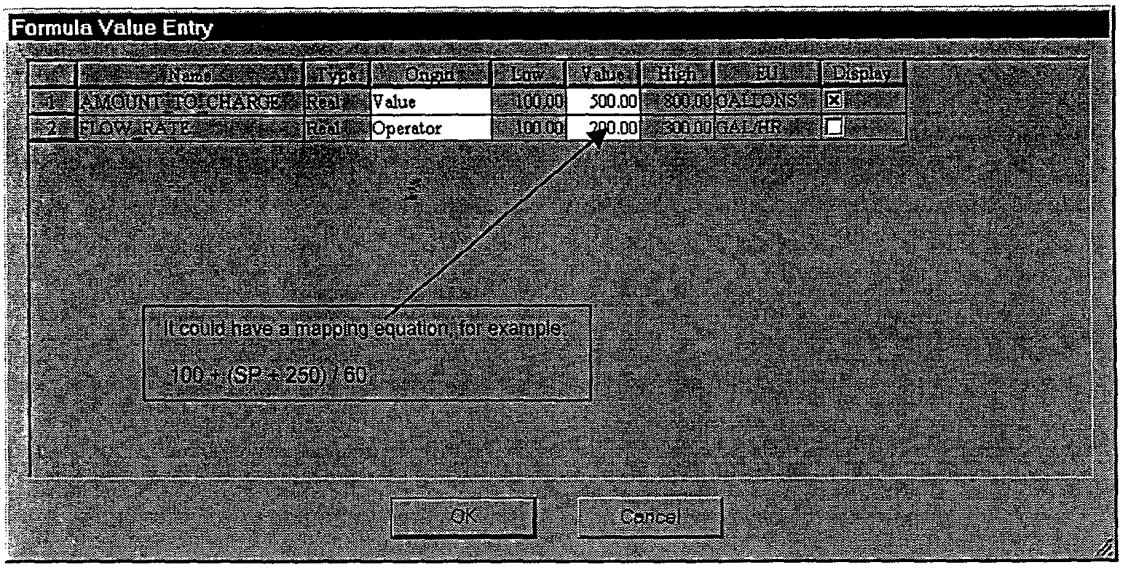

Fig. 91

20050930-022442

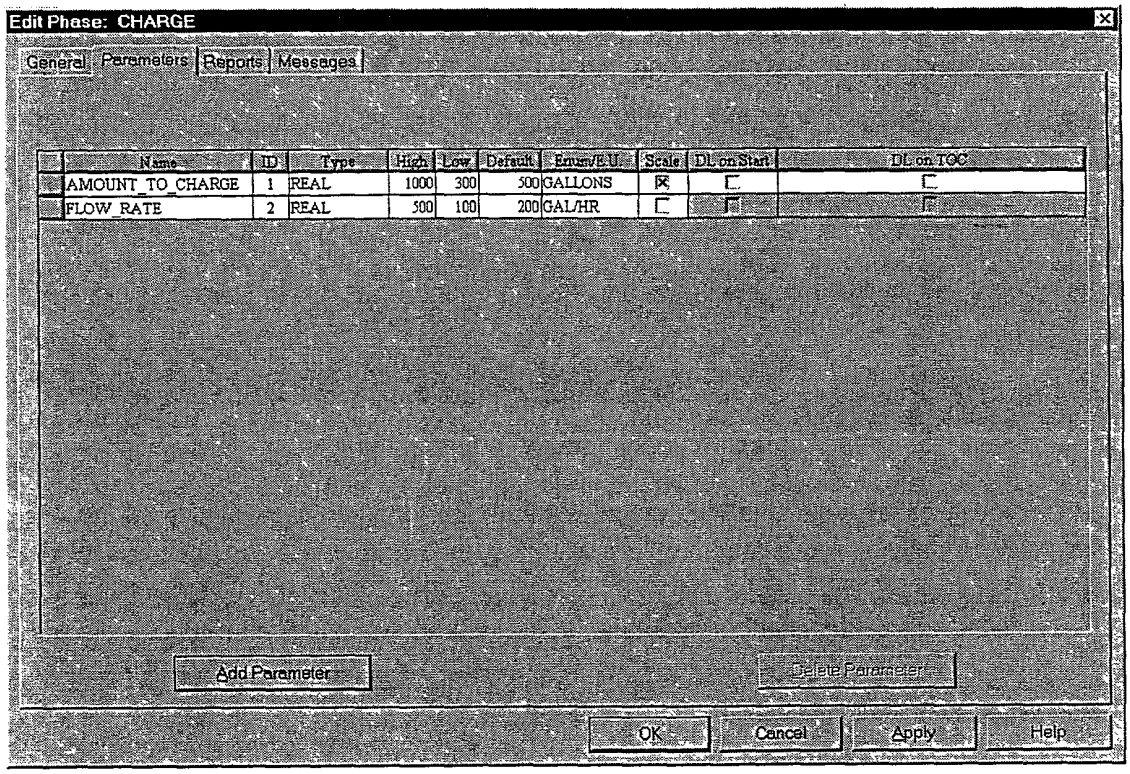
Edit Phase: CHARGE
General
Parameters
Reports
Messages
Name
ID
Type
High
Low
Default
Enum/E.U.
Scale
DL on Start
DL on TOC
AMOUNT_TO_CHARGE
1
REAL
1000
300
500
GALLONS
FLOW_RATE
2
REAL
500
100
200
GAL/HR
Add Parameter
Delete Parameter
OK
Cancel
Apply
Help

Fig. 92

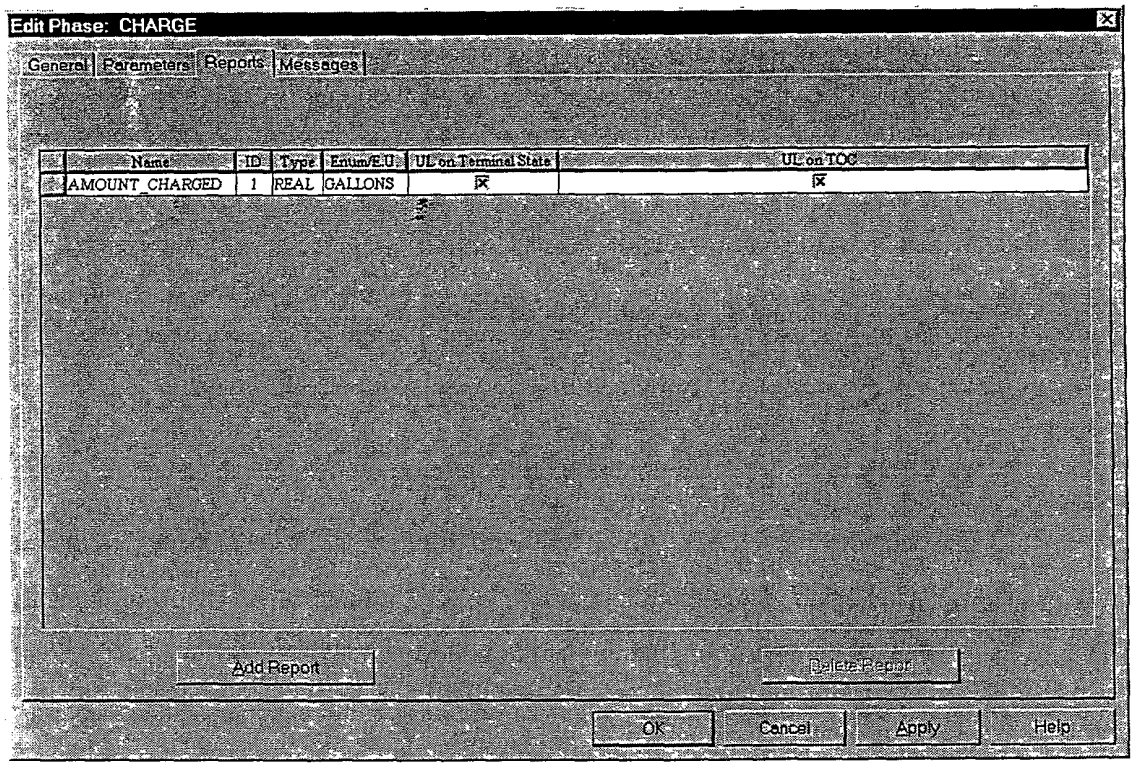
Edit Phase: CHARGE
General
Parameters
Reports
Messages
Name
ID
Type
Enum/E.U.
UL on Terminal State
UL on TOC
AMOUNT_CHARGED
1
REAL
GALLONS
Add Report
Delete Report
OK
Cancel
Apply
Help

Fig. 93

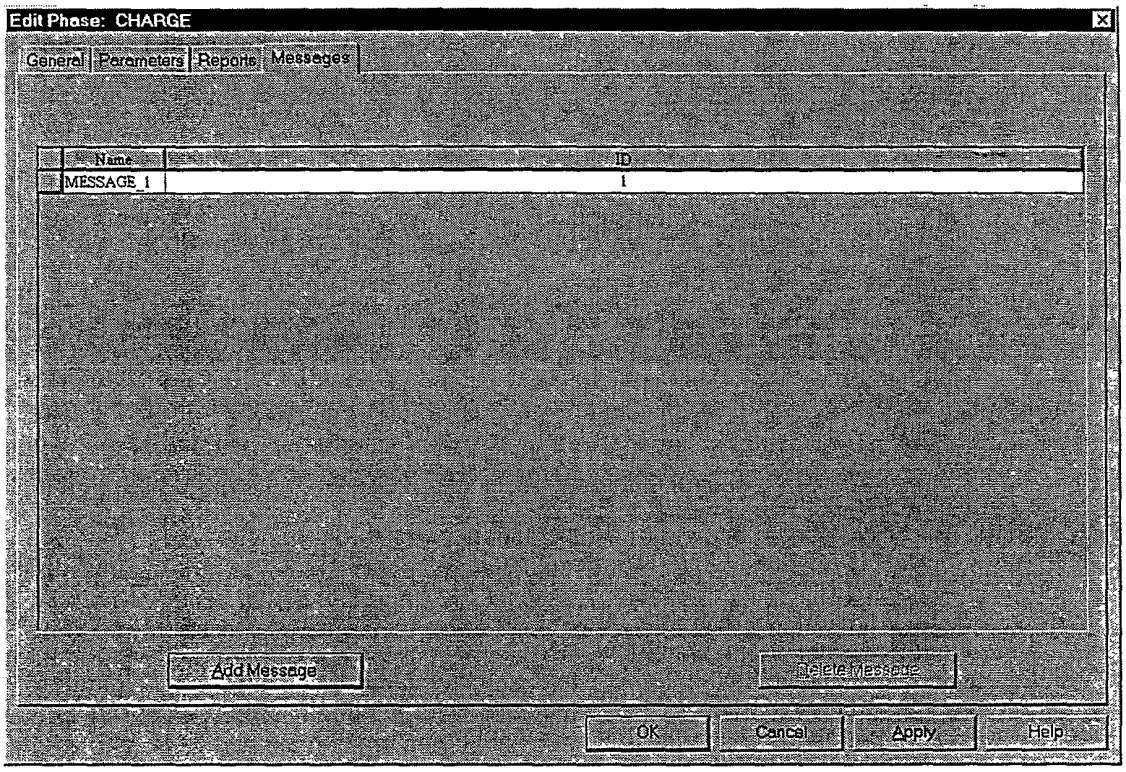
Edit Phase: CHARGE
General
Parameters
Reports
Messages
Name
ID
MESSAGE_1
1
Add Message
Delete Message
OK
Cancel
Apply
Help

Fig. 94

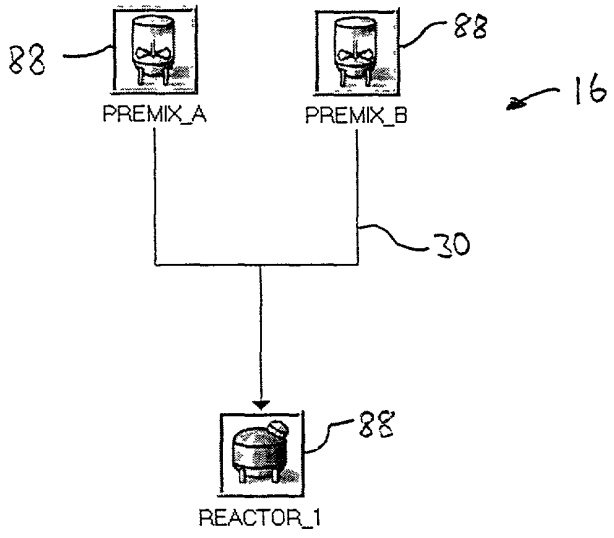
88
88
PREMIX_A
PREMIX_B
16
30
88
REACTOR_1

Fig. 95

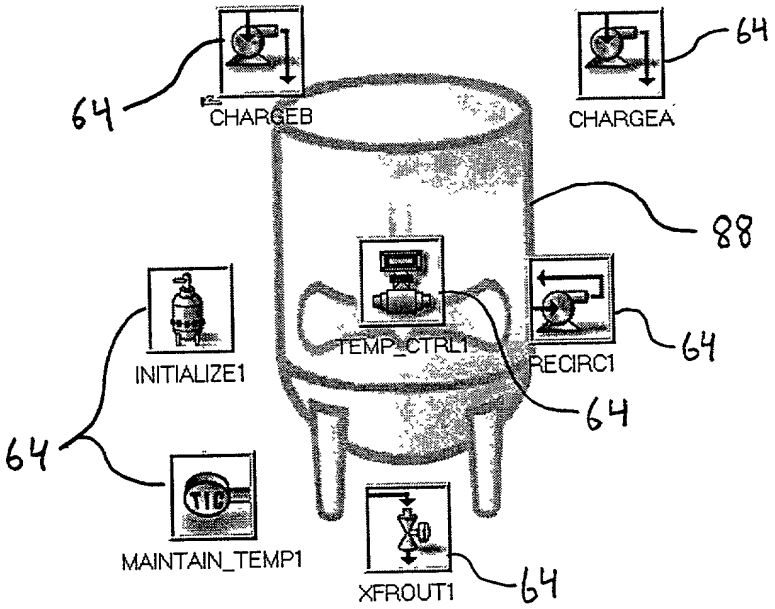
64
CHARGEB
64
CHARGEA
88
INITIALIZE1
TEMP_CTRL1
RECIRC1
64
64
64
MAINTAIN_TEMP1
XFROUT1
64

Fig. 96

4,965,745 10/23/90

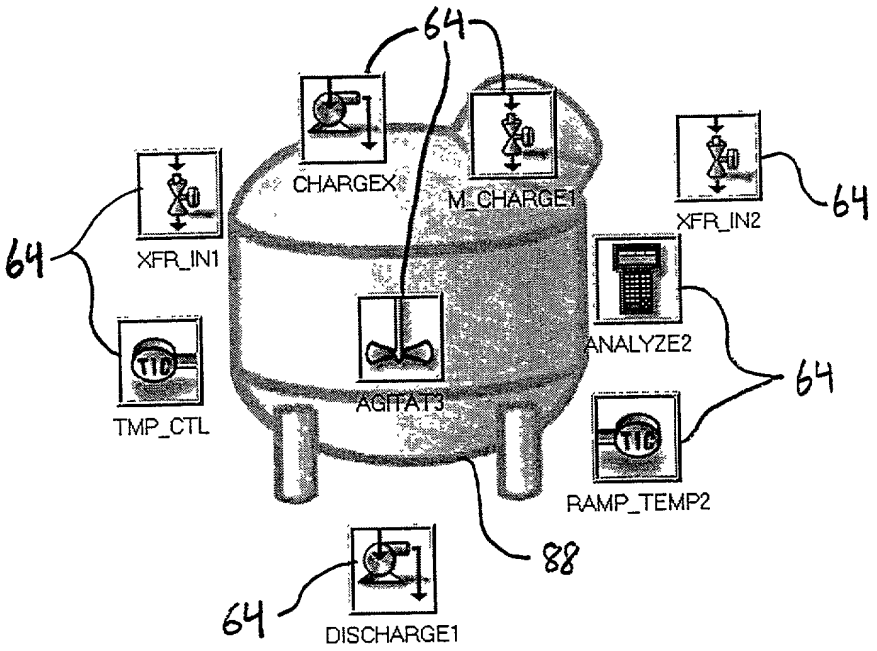

Fig. 97

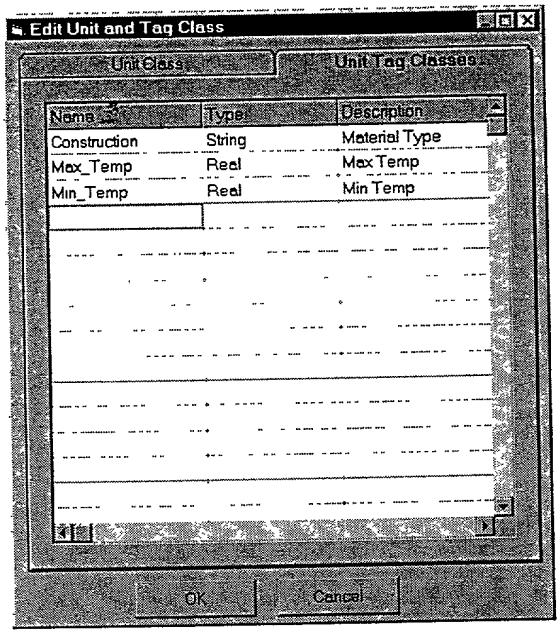

Fig. 98

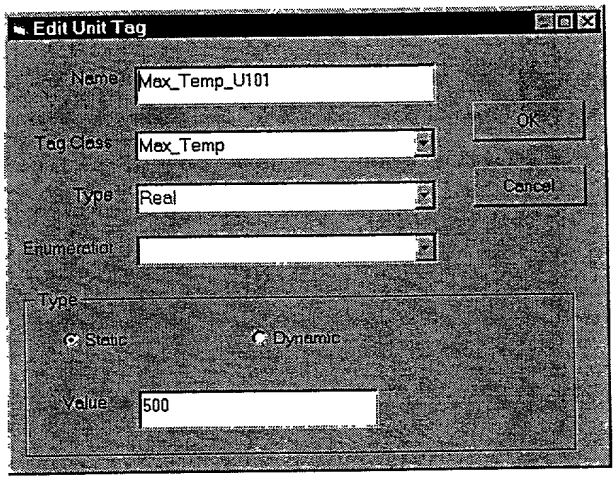

Fig. 99

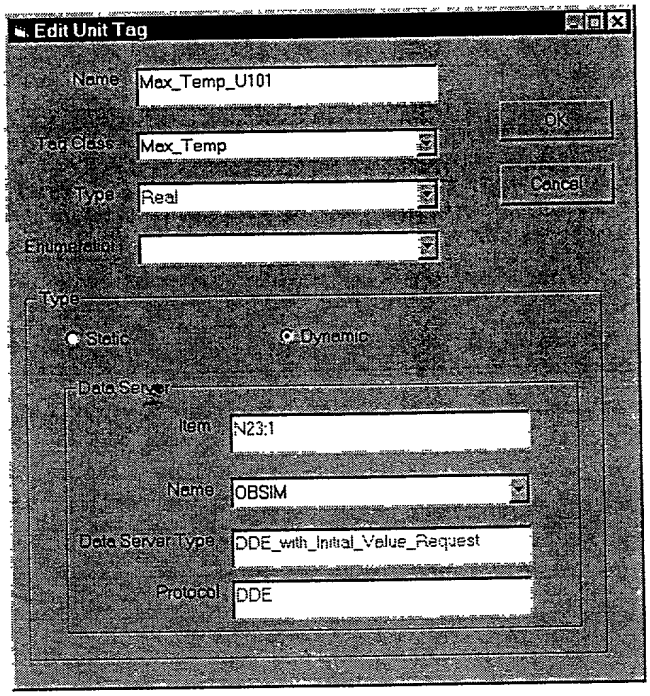

Fig. 100

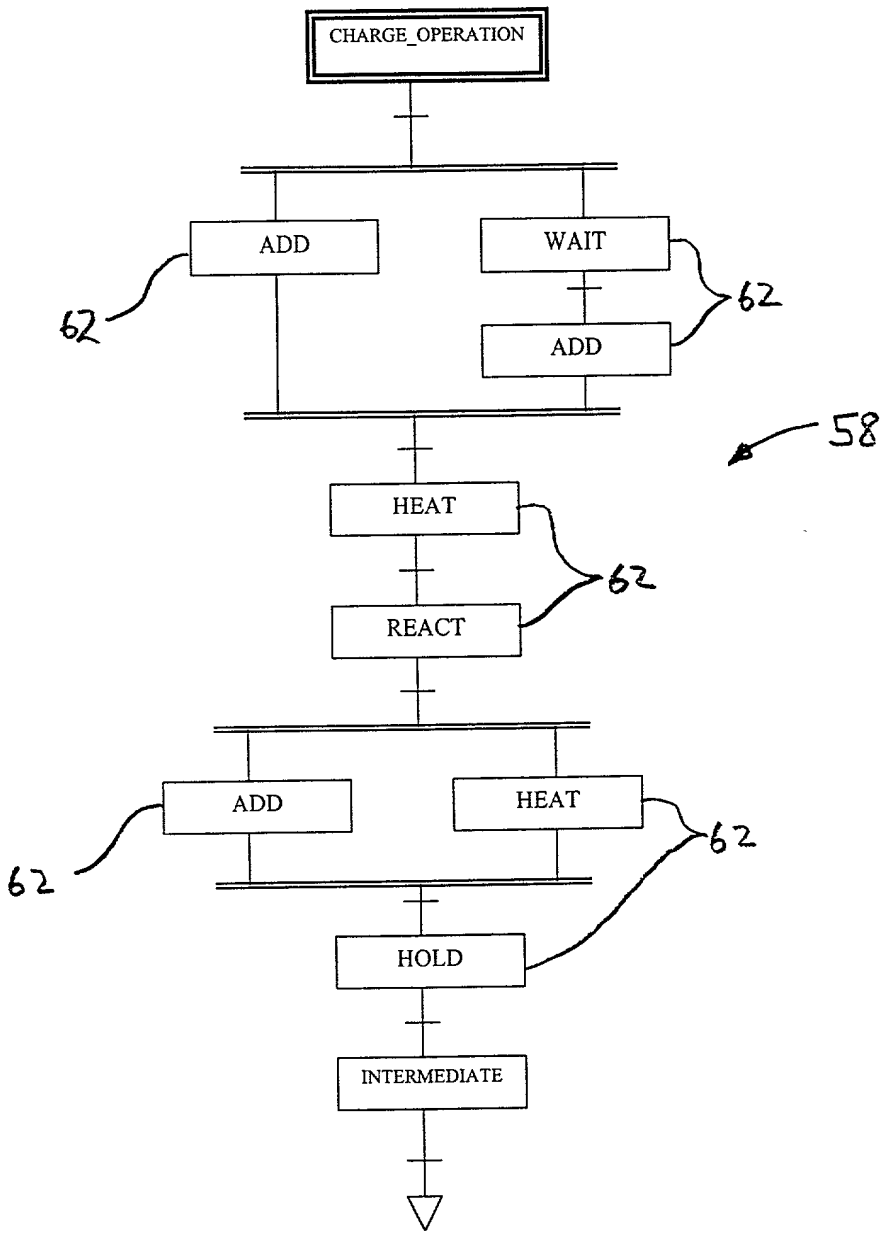
CHARGE_OPERATION
ADD
WAIT
62
62
ADD
58
HEAT
62
REACT
ADD
HEAT
62
62
HOLD
INTERMEDIATE

Fig. 101